PHILOSOPHICAL Transactions:

GIVING SOME

ACCOMPT

OF THE

Present Undertakings, Studies and Labours

OF THE

INGENIOUS

IN MANY

Considerable Parts

OF THE

WORLD.

VOL. X.

For the Year MDCLXXV.

LONDON,

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hood about Us. And it hath alwaies had the good fortune to be there best entertain'd, where the people were least rude, barbarous or savage. Nor is it the least glory of France, *that by their Hortulan industry, and by all the noblest kinds of Agriculture, they abound with delicate Fruit, acquired from all the known parts of the World, and with the richest materials for Trade, for Food and Rayments, with Silks and Wines; for necessaries, for ornaments, and for delights.*

We have therefore offer'd in these Papers some Instructions as Encouragements to increase *also* our *store, and to* advance *the excellency of our* inbred *Commodities. Here we have begun to lay good and large foundations, (that nothing may be wanting,) to enable us to follow the best Examples. Here we examine, what* our *Soyl, by Culture, and Mixtures or Composts, can be made, in the kindest manner, to produce or sustain. And we expect from the same Worthy Author, in good time, to be well instructed to understand, what our Climat will bear, either by Walls, Appendices, Solar Ovens, Marbled Stoves, for multiplied Insolations; or, what by cooling Conservatories, Vaults, Grotts, Rocks, Mounts, Streams, Fountains, Fountain-houses, or other refrigeratory Auxiliaries; that so the differing sorts of Vegetables may have the* most agreeable *entertainment, and* England *obtain some reputation also for valuable Exoticks.*

Mean while, for the general benefit of Mankind, *I have not omitted to record the growth of* Ingenuous Arts, *according to the best Intelligence which I have received, either from within, or from abroad. And me thinks, that* Astronomy, Geometry, *all the Noble* Mechanicks, *and especially* Architecture, *hasten to the highest perfection.*

Anatome *is esteem'd to have attain'd more in the last* Century, *than from all the foregoing Ages. And now the* Anatome *of* Vegetables *hath, within less than seven years, follow'd close to the heels of the best Anatomical discoveries of* Human *and* Animal *Bodies; and hath brought forth a very large and considerable branch of useful Philosophy. And the* History of Birds *is most fairly enlarged with very curious and Philosophical remarks. And we have grounds to expect shortly from the same Learned hands, a new History of the rest of* Animals. *These we may call* Two of the fairest Volums *of* Natur's Book, *next approaching to the System of Man's Fabrick.*

Thus, My Lord, *I have adventur'd to represent our Philosophical business, in a brief touch, rather than to offer any line of formal Complements, that I may take this opportunity to hold the* Works *that are before us in the* best Light, *to receive the more lustre from Your Lordships Name: And withal, I humbly conceive this to be the only acceptable way of giving to Your Lordship some such substantial satisfaction, as you may justly require from an engaged Votary in Philosophy, and from*

My Lord,

London,
February 21. 1675.

Your Lordships
Very humble and faithful Servant,

Henry Oldenburg, S. R. S.

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Chy-

Microscopical Observations of Mr. Leewenhoeck, *concerning the* Optic Nerve, *communicated to the Publisher in* Dutch, *and by him made* English.

HAving acquainted Dr. *Schravesande*, that I could perceive no cavity in the *Optic Nerve*, he told me, that *Galen* had on a clear Sun-shiny day seen a hollowness therein, encouraging me to view that Nerve again with more attention.

I took therefore, afresh, eight distinct *Optic Nerves*, and observed, that after those Nerves had been but a little while cut off from the Eye, the filaments, of which they are made up, did shrink up, which shrinking cannot be so much on the external surface or coat of the Nerve, as 'tis of the filaments that lie within the same: And upon this shrinking up, a little pit comes to appear about the middle of the Nerve; and 'tis this pit in all probability, that *Galen* took for a cavity. This I have remarked on all occasions.

Having lately viewed again an *Optic Nerve*, I not only saw the lately-mentioned little pit, but noted also several other places sunk in, as if each filament had been in the midst drawn inwards, after the manner by me described elsewhere.

I have also found, that this Nerve, when I let it be dried, was $\frac{3}{4}$ less in thickness than before; so much of it being dried away.

These Observations invited me to endeavour to dry an *Optic Nerve*, and to take care, that the same in its drying all at once, might retain (as much as was possible) the same roundness and thickness all over, as the Nerve had when it was first taken out of the Eye; considering that if there were a hollowness in it, it would then discover it self.

Having then dried such a *Nerve*, and made a transverse segment thereof, I not only saw in it a hole, but very many, which made it resemble a Leathern Sive, wherein are big and small holes, only with this difference, that the holes in the Nerve were not round (no more than they are not all of the same bigness) nor so regularly posited by one another, as the holes in a Sive are: But this piece of the *Optic Nerve*, together with the holes therein, is more like a piece of Parchment in which are made holes close unto one another, and the same moistned, and so stretcht out, whereby the holes in the Parchment keep not that roundness, which they had before moistening. These holes or cavities being in the dried Nerve, I am

of

of the ſame opinion ſtill (as I was before) that the nerve or fibres are made up of ſoft fluid globuls, and that theſe globuls by drying the Nerve are moſt of them exhaled.

I here thought with my ſelf, whether every one of theſe hollowneſſes might not have been a filament in the Nerve; and beſides, that 'twas needleſs, there ſhould be a cavity in the *Optic Nerve*, through which the Animal Spirits, repreſenting the ſpecies or images in the Eye, might paſs into the brain. But I imagined it might be performed, for example, after this manner; *viz.* I repreſent to my ſelf a tall Beer-glaſs full of Water: This Glaſs I imagine to be one of the filaments of the *Optic Nerve*, and the Water in the Glaſs to be the globuls of which the filaments of that Nerve are made up, and then, the Water in the Glaſs being toucht on its ſurface with the finger, that to this contact did reſemble the action of a viſible object upon the Eye, whereby the outermoſt globuls of the fibres in the Optic Nerve next to the Eye are toucht. This contact of the Water made by the finger cannot be ſaid to touch and move only the ſurface of the Water, but we muſt alſo grant, that all the water in the Glaſs is moved thereby, and that even the bottom of the Glaſs comes to ſuffer, and to be more preſſed by it, than it was before the finger touched the Water, and that alſo all the parts of Water are moved thereby. This motion then of the Water, ſaid to be made by the contact of the finger, I imagine to be like the motion of a viſible object made upon the ſoft globuls, that lie at the end of the Optic Nerve next the Eye, which outermoſt globuls do communicate the like motion to the other globuls ſo as to convey it to the Brain.

I have put before my Microſcope a piece of ſuch a dried Optic Nerve of a *Cow*, and how it appeared, you will ſee by the picture hereby tranſmitted unto you.

A, *B*, *C*, *D* is the circumference of the *Optic Nerve*, which did not dry round-ways, but ſomewhat oblong on the ſide *C*, *D*.

E, and all the places that are left white and lucid, are cavities in the dried Nerve, and which I imagine to have been filaments, and out of which, for the greateſt part, the ſoft globuls have been exhaled.

F, are particles or globuls, which are in the little holes of the filaments in many places, and ſuch as have not been exhaled: Of which ſome do lie on the ſide of the hollowneſſes, others lie round

about a cavity, others lie croſs a cavity, as *G*. All theſe particles were eminently tranſparent.

About *A*, *B*, *C*, *D*, there are near the edge of the Nerve ſome tranſparent winding ſtroaks.

Other Microſcopical Obſervations, made by the ſame, about the texture of the Blood, the Sap of ſome Plants, the Figure of Sugar and Salt, and the probable cauſe of the difference of their Taſts.

IN my former I told you, how that the clearer aqueous matter of the Blood, being that Liquor in which the red ſanguineous globuls ſwim, doth likewiſe conſiſt of globuls; and that I had obſerved ſuch in that aqueous matter, when the moiſture was ſomewhat, or for the moſt part, exhaled. But now I cannot omit to acquaint you, that a few daies after I had ſent away that Letter, I ſaw the plain globuls move in that wateriſh matter without any evaporation made; though there were but very few of them, and they appeared white where they lay together. And on this occaſion I very well remember, that, about two years ago, I divers times obſerved my own Blood, and noted, that thoſe ſanguineous globuls that make the Blood red, ſeemed then to be firmer and harder than they are in my Blood now; at which time my Body was very much indiſpoſed, ſo that I fell into a ſickneſs, which held me near three weeks: But now I find thoſe globuls of my Blood ſofter, and more ſticking to one another, and my Body in a good ſtate of health. I know not, whether ſome ſickneſſes, and even death it ſelf, may not ſometimes proceed from the hardneſs of thoſe globuls. I am apt to imagine, that thoſe ſanguineous globuls in a healthy Body muſt be very flexible and pliant, if they ſhall paſs through the ſmall capillary Veins and Arteries, and that in their paſſage they change into an oval figure, reaſſuming their roundneſs when they come into a larger room.

Beſides this, I have obſerved in the clear matter of the Blood figures of a quadrangular form, which I ſuppoſe to be ſome ſalin parts; further to be examined hereafter.

But I ſhall proceed to give you an account of the Obſervations I have made of the Sap of ſome Plants. *Arum* (*Wake-robin*) being taſted by me, and found very ſharp upon the tongue, I found by my Microſcope, that the Leaf thereof did conſiſt of globuls not exactly round, and theſe again of particles incomparably

ſmaller

ſmaller than thoſe. Having pulled the Stalk from the Leave, and tranſverſly cut it thorough, I diſcovered in the parts of this Stalk (which I ſhall call *Pores*) very thin Figures, which at length appeared to me in *my* Microſcope, of the thickneſs of a great Bread-knives back, and its thickneſs of that of a Spiders web, when ſeen by the naked Eye. Theſe fine Figures lay in the ſaid Pores in a heap, in ſome, ten or fifteen of them together. Having cut ſome of the Leaves of this Herb in pieces, upon a clean Pewter-plate, and ſqueez'd the Juyce out of it, I found it ſo thick of its ſmalleſt parts, that it ouſed but very ſlowly through blew Paper; and looking upon this ſtrained Juyce, I found it alſo ſo thick, and ſo ſticking, that I could obſerve nothing therein but partly abundance of ſmall particles, which by reaſon of their ſmallneſs appeared not figured, partly ſome bigger parts, which likewiſe, by reaſon of their ſticking matter, yielded no Figure to my Eye. But then viewing the thicker part of this Juyce, which remained behind in the Blew-paper, I ſaw, that that conſiſted almoſt all, excepting a little Sap, of the ſaid very ſmall particles, of which more than a thouſand make one globul, and of which the Leaf was made up. And I imagined, that I ſaw, between the very ſmall particles, ſome little Figures or Pipes, as I ſaid I had ſeen in the pores of the ſtalk of the Leaf. But this I could not perfectly diſcern, by reaſon of the various parts that were in the Sap, how thin ſoever I ſpread it, and repreſented it to me. Holding ſome of the ſaid thick Sap to a little fire, by which the ſaid particles of the Leaf did in part burn away, I then noted very many of the ſaid thin ſmall figures or pipes, which I had ſeen in the Stalk of the Leaf. Theſe little pipes were of a much firmer matter, than the particles which the Leaf was made up of; for, though I ſuffered moſt of the little particles of the Leaf to burn away in ſome places, yet the ſaid ſmall Pipes remained almoſt entire, without any viſible detriment to them. And I afterwards ſaw in the expreſſed Sap of *Arum*, without holding it to the fire, the ſame little Pipes moving very plainly. And when after this, upon the fading of the Leaf, the ſeed upon the Stalk being yet green, I expreſſed the ſap out of the Stalk, I perceived alſo the little pipes in this expreſſed Sap.

Now 'tis likely, that theſe Pipes in this Herb are the cauſe of the ſmart that is felt in chawing the *Arum*, by the motion of the moiſt

moist Tongue in tasting: For that there may be a long-lasting motion, remaining in Liquors or Saps upon a little stirring (which in our case occasions the pain,) hath been divers times by me observed, and particularly in Water frozen in Winter, affixed to the pin of my Microscope: In this little Icy particle, though it be no bigger than a small pins head, I saw, as soon as it thawed, very many terrestrial particles moving in the water, (which before the congelation were not visible,) and continuing so long in that motion, that my eyes were tired with looking on. The like motion I have noted in the Juyce, squeezed out of the upper peel of a fresh Limon, wherein those little globuls, of which that peel is composed, do move, which are loosened by the squeezing of the Juyce. This motion of the said particles in the moisture is very pretty to behold, and many Spectators would swear they were little living Animals. Observing this motion, I conceived, that the motion of the sharp particles that are in some Saps, was not less, especially being set on by the motion of the Tongue.

What further concerns in general the Saps of Herbs observed by me, I find in them peculiarly figured small bodies, but that for the most part in such as I have suffered part of the moisture to be exhaled from. But such little Pipes, as I have mentioned to be in the Herb *Arum*, I have not discovered in any other Plants, hitherto viewed by me, but in the Sap of green *Vine-branches*, and *Asparagus*, and very many of them in the Sap of the stalk and leaves of *Cataputia* (*Spurge*,) and some few in the Sap which I squeezed out of the Root of *White Hellebore*. But to discover the vertues and operations of Herbs from the figures of their Saps, is an undertaking as yet too difficult for me. For, suppose there were half a score sorts of Herbs, in the Saps of which there were found one and the same Figure, as for example, such an one, in which the *basis* of the figure consists of a triangle, or quadrangle, and the sides of them running up to the shape of a Pyramid, after the manner of a well polisht triangular or quadrangular pointed Diamond (for such a Figure I have discovered in some saps of Herbs;) I am then to imagine, that, when I see such or the like figures in Saps, their beginning hath been a thousand or more times smaller; I must think besides, that we cannot discover any of the minute particles of any Sap, with the most perfect Microscope, but the little figure of them hath been from its beginning much smaller:

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I esteem also, that when it is very small, it hath the same form and fashion with that when grown bigger, and being grown bigger, that 'tis composed of the said very small particles. Now, if these little figured parts of those Saps, which I suppose to be the smallest of that kind, and yet such, as that the *basis* of them is triangular or quadrangular, and that besides they are all alike strong, or equally flexible; if these, *I say*, did lye upon our Tongue, and were pressed against the globuls of our Tongue, and none of them all were altered by moisture or warmth, I should then judge, that all those little Figures of the said saps of Plants would have one and the same taste and operation.

To illustrate which, I shall here speak of the difference of the taste between *Salt* and *Sugar*. The grain of *Sugar* then consists of divers pointed and angular small Figures; and yet how angular and pointed soever these Figures are, they would not, if they remained intire, cause any taste upon our Tongue, forasmuch as (with submission to better Judgment,) their angles and points are big, each point or angle of these grains of Sugar not touching one or two globuls of our Tongue, but comprizing a great number of them; and that the rather, because I take it for granted, that a single globul, (of which bodies the pointed protuberances of our Tongue are made up,) is many thousand times smaller than a common grain of Sand, and therefore can produce no taste. For, take a polisht pointed Diamond, of an ordinary bigness, and put it on the back of your hand with the point downward, and press it upon your hand with the force of a pound weight; this pressure will cause but little smart to the hand, in regard that the pressure or force, put to the Diamond, doth not only touch the extream point of a Diamond, but many other points, forasmuch as our skin, being soft and pliable, will, where that extream point comes to touch, sink a little inward, and so, according to the bigness of the Diamond, will close about the whole, or the greatest part of the same; whereby the skin will be touch't, as was said, not in one only point, but in many, though indeed most of all by that which is the sharp end of the Diamond. Now this seems to be the reason, why *Sugar*, if it were so hard and rigid as not to be dissolved in water, or warmth, would be insipid, forasmuch as it would not cause any pungency upon the globuls of the Tongue, when the Sugar-grains lye thereon, by reason of the small pressure made by the Tongue against the roof

of

of the mouth. But then, if we ſhould ſuppoſe, that a Diamond were thouſands of times leſs, and were put upon our hand with the preſſure of one pound weight, it would then not only cauſe ſmart, but doubtleſs, if no bones did hinder, run through the whole hand. Juſt ſo, if the ſmall grains of Sugar were thouſands of times leſs than they are, and rigid withal, then their points would not touch many globuls at once, but only one globul, and ſo would produce no pleaſure but pain, for with their ſharp angles they would wound the globuls of our Tongue. But, Sugar is a body diſſoluble in water, and that the more readily if warmth do accompany it. Wherefore that ſubſtance, when put upon the Tongue, is diſſolved by the moiſture and warmth it meets with there, and unites with the *Saliva* of the mouth, and ſo proves even ſmooth and ſoft upon the Tongue, affecting it with pleaſure. But *Salt*, on the contrary, though it diſſolves in water as to its great parts, yet doth it retain ſome rigid ſmall particles, which by warmth, when they are taken upon the Tongue, grow yet more rigid, and are ſo ſubtile, that they *prick* the globuls of our Tongue, though not ſo ſtiff, that they *wound* them.

To this I ſhall add my Obſervations about *Manna*: This ſubſtance I have found to conſiſt of long ſmall pipes, which I have ſeen, when put in water, to unite therewith as Sugar doth, and on that account is alſo ſweet upon the Tongue. And repreſenting that water to my eye as thin as I could, and ſuffering it to exhale, it afforded very pretty pipes; and adding ſome more warmth to it, thoſe Pipes grew ſomewhat ſtiffer. Seeing this, I imagined, that as *Manna* diſſolves in a little warmth, and in water, (both which is found upon our Tongue,) ſo in more warmth, which it meets with when taken down into our body, it changes into the ſaid pipes: And, in regard that by the pricking of them there is cauſed in the globuls of our Bowels an unuſual, preternatural and ſtronger commotion, the chyle that is there is carried off more ſtrongly and more ſpeedily, taking along with it that matter, which by the impulſe of the pipes on the bowels is looſen'd. And adding yet ſome more fire to the pipes of the *Manna*, they turn'd into a kind of ſyrup. This gave me thoughts, that the ſaid pipes, not being ſtrong, did work but ſoftly upon our Bowels, and that this poſſibly was the cauſe of their kind operation; as alſo, that there being ſome bodies, in which there might be inwardly on extraordinary heat, the *Manna* might there, inſtead of ſhooting into pipes, turn

into

into a ſyrup, and ſo produce little or no effect as to purgation.

But to return to the matter whence we have digreſſed, I mean to the ſameneſs of Figures in ten ſorts of Saps of Herbs, it may come to paſs, that each of theſe Saps may, notwithſtanding the identity of that Figure, yield a peculiar taſte differing from the reſt. For, ſuppoſe the ſmall Figures that are in one Sap of the ten Herbs, to be of ſuch a ſtiffneſs or hardneſs, as that they do in ſome degree affect the globuls of our Tongue, and ſo produce a taſte proportionable; if the Figures of the Sap of another of thoſe Herbs be a degree ſtiffer or harder, and ſo on of the reſt, then will each degree of hardneſs in thoſe Figures cauſe more or leſs ſharpneſs of taſte upon our Tongue, and conſequently produce a ſutable operation.

What I have obſerved in the examination of ſeveral ſorts of *Wines* (in moſt of which I have diſcovered exceedingly pretty Figures) I muſt refer to another opportunity. Mean time, I ſhall be glad to hear how theſe my Obſervations are received, and what Objections are made againſt them, remaining

Yours, &c.

Some Optical Assertions concerning the *Rain-bow*, transmitted by the Learned *Franciscus Linus* from *Liege*, where they were publickly discussed in *August* last: Deliver'd here in the same Language, wherein they were communicated.

I. *Minima quævis Pluviæ guttula, radiis Solaribus illustrata, mittit ex se* Iridem *perfectam, non solùm quoad ipsos Colores, sed etiam quoad eorum Ordinem, Situm, ac Figuram circularem, ei quam in Cœlo videmus simillimam.*

II. *Radii enim Solares guttulam sub-intrantes, indeque post duas Refractiones & unam Reflectionem, iterùm versùs Solem redeuntes, erumpunt è guttula colorati, iisdemque planè coloribus, quos in Iride videmus, rubro, flavo, viridi, cæruleo, & purpureo imbuti.*

III. *Hi radii sic colorati, dum pluvioso cælo à variis guttulis Sole illustratis in oculum transmittuntur, Visionem, quam de Iride habemus, efficiunt.*

IV. *Dantur autem in qualibet guttula duo Annuli, Major & Minor, distinctis coloribus Irialibus imbuti; quorum* Minor *distat ab axe seu radio transeunte per centrum guttulæ, gradibus circiter* 21; Major *autem ab eodem axe distat gr.* 78. *Radii autem incidentes in Minorem annulum, inde resiliunt in Majorem; è quo erumpentes in aërem, dictis coloribus Irialibus imbuuntur.*

V. *Oriuntur igitur hi colores à radiis Solaribus; sed non ab iis solis (uti hactenus existimatum) sed etiam à radiis ipsius Aeris, corpus Solare ambientis.*

VI. *Sed neque oriuntur hi colores ab omnibus iis radiis, sive Solaribus sive Aeriis, qui guttulam sub-intrant; sed ab iis solummodò, qui emittuntur ab ipso Limbo solari, Aereque ei vicino.*

VII. *Quin & ii radii, qui sic à limbo Solari Aereque vicino in guttulam transmittuntur, non omnes spectant ad dictos colores, nec erumpunt colorati; sed illi duntaxat, quorum Angulus Incidentiæ nec minor est gradibus* 45, *nec major gradibus* 75.

VIII. *A Limbo itaque Solari, vicinoque Aere procedunt colores Iriales, non tamen omnes quinque* immediatè *inde fluunt; sed quatuor duntaxat, nempe Ruber, Flavus, Cæruleus & Purpureus: Viridis*

Viridis enim oritur ex radiis flavis & cæruleis inter se permixtis.

IX. *Oriuntur igitur hi quatuor colores à dicto Limbo; non tamen omnes ab una eademque ejus parte: Sed duo ex iis ab una parte Limbi, & alii duo ab alia, ei directè oppositâ*; v. g. *à limbo superiore oriuntur Cæruleus & Purpureus, & ab inferiore, Ruber & Flavus.*

X. *Causa autem, cur à Limbis adeò inter se similibus oriantur colores tam dissimiles, non alia hîc apparet, quàm quòd in uno casu limbus Aerius sit supra limbum Solarem; & in alio, limbus Solaris sit supra Aerium. Hoc autem discrimen videtur hîc sufficere, eò quòd ratione illius diversi Situs nunc radii Solares incurventur per refractionem supra radios Aereos; nunc è contra Aerii supra Solares.*

XI. *Oriuntur itaque hi Colores per dictos radios Refractos, ita tamen refractos, ut per eam refractionem valdè inter se constipentur. Nam omnes radii à gradu* 45 *usque ad* 60 *ad spatium* unius *gradus in* minore *annulo contrahuntur: In quod etiam tam angustum spatium confluunt, per retrogradationem, radii omnes à gradu* 60 *ad* 75.

XII. *Quando plures homines simul vident Iridem, tot videntur Irides, quot sunt homines videntes.*

XIII. *Qui intuetur Iridem, videt singulis momentis aliam & aliam.*

So far these Assertions; which we thought fit to insert here, to give the Curious and Learned amongst us the opportunity to consider them, and to give-in their thoughts upon them; which we are perswaded will be very welcom to the Author.

Obſervationes Eclipſis Lunaris, habitæ *Pariſiis*; comparandæ cum iis, quæ peractæ fuerunt *Londini* d. Junii 26. 1675. *ſt. Veteri*, traditæque in his Actis Phil. *num.* 116. *p.* 371.

Julii 7. 1675. *ſt. novo*, *mane*, *in Regia Specula Aſtronomicâ*, *Cl. Viri*, Caſſinus, Picartus & Romerus, *ſummâ quâ poterant curâ obſervârunt tempora*, *quibus Umbra Terræ per diverſas Lunæ maculas ſucceſſivè tranſiit*, viz.

Temp. H. M. S.		Tranſitus Umbræ.
1. 56. 45	Initium.	Infra Grimaldi.
1 57 20		*Per primum limbum Grimaldi.*
58 50		*Secundum limbum Grimaldi.*
2 1 45		*Galilæum.*
2 15		*Primum limbum Merſenni.*
4 15		*Initium Gaſſendi.*
4 40		*Medium Gaſſendi.*
5 30		*Alterum limbum Gaſſendi.*
6 15		*Herigonum & Seleucum.*
7 45		*Morinum.*
8 18		*Medium Kepleri.*
11 35		*Ariſtarchum & Bulialdum.*
12 40		*Ariſtarchus diſparet.*
16 25		*Initium Tychonis.*
16 40		*Initium Copernici.*
17 25		*Medium Tychonis & Copernici.*
18 12		*Alterum limbum Tychonis.* (*diorum.*
21 45		*Pytheam & primum trium Sinuum me-*
24 0		*Medium ſecundi Sinûs medii.*
24 35		*Heraclidem vel Virginem.*
26 10		*Primum limbum Timocharis.*
26 40		*Medium Timocharis.* (*nem.*
31 40		*Promontorium inter Virginem & Plato-*
32 20		*Abulfedam.*
34 15		*Initium Manilii.*
36 15		*Dionyſium Areopagitam.*

H. M.

H.	M.	S.	
2	38	10	*Per Litus Maris tranquillitatis.*
	38	45	*Primum limbum Menelai & Platonis.*
	39	20	*Fracaſtorem.*
	39	50	*Medium Platonis.*
	41	15	*Alterum limbum Platonis.*
	44	15	*Promontor. inter Conſorinum & Bedam.*
2	50	20	*Primum limbum Paludis ſomnii.*
	50	45	Cornua erant Verticalia.
	53	55	*Initium Langreni.*
	55	20	*Primum limbum Maris Caſpii.*
	1	10	*Alterum limbum Maris Caſpii.*
3	1	45	*Endimionem.*
	3	15	*Meſhalam.*
	7	45	Fin. *ſive* Totalis Immerſio, ſupra Mare Caſpium.

Teleſcopiorum adhibitorum unum erat pedum ſex, reliqua, pedum trium. Mare Caſpium *tunc diſtabat à limbo Occidentali circiter* $\frac{3}{4}$ *ſuæ latitudinis. Poſt Immerſionem Totalem dignoſcebatur adhuc totum corpus Lunæ; at tandem Aurora emicans & vaporoſus Horizon, ipſam, priuſquam occideret, oculis ſubduxêre.*

Has obſervationes, ad Longitudinum cognitionem conducentes, præceſſit alia obſervatio, haud minùs ad idem negotium faciens: Equidem ante mediam noctam, horâ ſcil. 11, *&* 16 *ſecondis præcisè, ſecundus Jovis ſatelles egredi incipiebat ex Planetæ hujus qui ipſum obſcuraverat umbra: Id quod obſervatum fuit eximii* 20 *pedum Teleſcopii beneficio.*

A Letter written to the Publisher by the Excellent *Cassini*, relating to the foregoing Observations.

OBservationes D. Flamstedii *circa novissimam Lunæ Eclipsin cum nostris in Regio Observatorio habitis magna cum voluptate contuli. Ex iis quippe* differentiam Meridianorum, *quam olim, nostrarum Observationum collatione*, Minutorum 11 *definieram, nunc decem novis Comparationibus eandem intra pauca* Secunda *video confirmari. Integram Observationem nostram, utpote in* Diario *editam, & ad Te transmissam, minimè transcribam: Comparationes duntaxat à me initas hîc subjiciam, ut nostrarum Observationum appareat consensus: De quo eo magis mihi gratulor, quòd, cùm Observationes aliæ ejusdem Eclipseos, alibi locorum habitæ nobisque communicatæ, procul ab ea concinnitate abesse deprehenderimus, Nostrarum cum Vestris eximius consensus utrisque conciliet authoritatem.*

Astronomicam Speculam à Vobis adornari, eique eundem eximium Flamstedium *præfectum esse, valde gaudeo. Quid ex ejus diligentia experientiáque sperandum sit, tum ex hoc specimine, mihi à Te transmisso, tum ex aliis patet. Vale, Vir Clarissime, & eidem D.* Flamstedio *meo nomine, si placet, salutem precare.* Parisiis *d.* 7. *Augusti* 1675.

Observat. D *Flamstedii.*	h. ′ ″	Observationes nostræ.	h. ′ ″	Differentia Merid.	′ ″
Pentadactil. tectus.	13. 55. 15.	*Idem seu Seleucus.*	2. 6. 15.	11.	0 11. 0.
Porphyrites tectus.	14. 2. 20.	*Idem seu Aristarchus.*	2. 12. 40.		10. 20.
Sinæ limbus primus.	14. 5. 30.	*Ejusdem seu Tychonis.*	2. 16. 30. * vel 16. 25.		11. 0. * 10. 55.
Ætnæ limb. primus.	14. 6. 0.	*Ejusd. seu Copernici.*	2. 16. 30. * vel 16. 40.		10 30. * 10. 40.
Besbici limbus prior.	14. 23. 5.	*Ejusd. s. Manilii med.*	2. 34. 15.	*Minor quam*	11. 5.
Horminius tectus.	14. 26. 3.	*Ad eund seu Dionys.*	2. 34. 15.	*Major quam*	10. 12.
Tetigit limbum primum Corocondometis.	14. 39. 30	*Ejusd. s. Paludis somni.*	2. 50. 20.		10. 50.
Tetig palud. Mæotid.	14. 45. 0	*Eand. s. Mare Casp.*	2. 55. 20. * vel 55. 40		10. 20. * 10. 40.
Mæotis tota tecta.	14. 50 40	*Eadem.*	3. 1. 10.		10. 30.
Immersio.	14. 56. 55.	*Immersio.*	3. 7. 45.		10. 50.
		* vel	7. 40.		* 10. 45.

*Nota hæc * denotat D.* Cassini *peculiarem existimationem; in reliquis cum D. D.* Picardo *&* Romero *consentit.*

An Extract of a Letter of July 28, 1675. *by Mr.* Lister *from* York *to the Publisher; containing some Observations about* Damps, *together with some Relations concerning odd Worms vomited by Children*, &c.

SIR,

I Shall Transcribe for you a Letter, I had very lately from Mr. *Jessop*; which is as followeth:

As to what concerneth *Damps*, I shall give you a brief account of what is generally said and believed. If you find any thing worth a further enquiry, if you please to send your Queries, I will endeavour to get the best information I can. There are four sorts common in these parts.

The first is the *Ordinary* Sort, of which I need not say much, being known every where; the external signs of its approach are the Candles burning orbicular, and the flames lessening by degrees until it quite extinguish; the internal, shortness of breath. I never heard of any great inconvenience, which any one suffer'd by it, who escaped swooning. Those that swoon away, and escape an absolute suffocation, are at their first recovery tormented with violent Convulsions, the pain whereof, when they begin to recover their senses, causeth them to roar exceedingly. The ordinary remedy is to dig a hole in the earth, and lay them on their bellies, with their mouths in it; if that fail, they tun them full of good Ale; but if that fail, they conclude them desperate. I have known some, who have been recovered after this manner (when some of their Companions at the same time have died) that told me, they found themselves very well within a little while after they had recovered their senses, and never after found themselves the worse for it.

They call the second sort the *Pease-bloom Damp*, because, as they say, it smells like Pease-bloom. They tell me, it alwayes comes in the Summer time, and those Groves are not free, which are never troubled with any other sort of Damps. I never heard that it was mortal, the scent perhaps freeing them from the danger of a surprise: But by reason of it, many good Groves lie idle at the best and most profitable time of the year, when the subterra-

ſubterraneous waters are at the loweſt. They fancy, it proceeds from the multitude of Red *Trifoil-flowers*, by them called *Honey-ſuckles*, which with the Limeſtone Meadows in the *Peake* do much abound. Sr. *W. Petty*'s duplicate proportion † might perhaps render this ſcent ſenſible at a great diſtance, eſpecially in a narrow Cavern, but ſcarcely intolerable, or as they find it, malignant.

† See this Diſcourſe of this Subject, printed by Mr. *Martin*, 1674.

The third is the ſtrangeſt and moſt Peſtilential of any, if all be true which is ſaid concerning it. Thoſe who pretend to have ſeen it (for it is viſible) deſcribe it thus: In the higheſt part of the roof of thoſe paſſages, which branch out from the main Grove, they often ſee a round thing hanging, about the bigneſs of a Foot-ball, covered with a skin of the thickneſs and colour of a *Cobweb*: This, they ſay, if by any accident, as the ſplinter of a Stone, or the like, it be broken, immediately diſperſeth it ſelf, and ſuffocates all the company. Therefore to prevent caſualties, as ſoon as they have eſpied it, they ſay, they have a way, by the help of a ſtick and a long roap of breaking it at a diſtance; which done, they purifie the place well by fire before they dare enter it again. I dare not avouch the truth of this ſtory in all its circumſtances, becauſe the proof of it ſeems impoſſible, ſince they ſay, it kills all that are likely to bear witneſs to all the particulars: Neither dare I deny, but ſuch a thing may have been ſeen hanging on the roof, ſince I have heard many affirm it. Perhaps the general Tradition they have amongſt them, hath made them aſcribe all ſtrange and ſurpriſing effects unto this cauſe. They are not without a reaſon for it, which is not altogether irrational, if the matter of fact be true; for they ſay, the ſteam which ariſes from their bodies and the candles, aſcends unto the higheſt part of the Vault, and there condenſeth, and in time hath a filme grows round about it, and at length corrupting becomes peſtilential: Thus have I heard many of our under-ground Philoſophers diſcourſe.

The fourth which they alſo call a Damp (although how properly, I will not now argue) is that vapour, which being touched by their Candle preſently takes fire and giving a crack like a Gun produceth the like effects, or rather thoſe of Lightning. A Fellow, they commonly call *Dobby Leech*, is at this day a ſad example of the force of one of thoſe blaſts in *Haſleberg-hills*, having his

his arms and legs broken, and his body ſtrangly diſtorted. Capt. *Wain* told me, he ſaw one of them in a Bloomery near *Peniſton*. But I ſhall ſay no more of them, becauſe I have juſt now ſuch an opportunity of informing my ſelf about this matter, as I am never like to have again as long as I live. For at *Wingerſworth*, two miles beyond *Cheſterfield*, within this month or five weeks, a Cole-pit of Sr. *F. Humblocks* hath been fired four times by this vapour, and hath hurt four ſeveral Men. I will not ſend you the particulars, becauſe I intend to ſend you them, when I can do it of mine own knowledge; alſo I received a Relation of it from thoſe who ſpoke with ſome of the wounded Men. I pray you furniſh me with *Quæries* upon this Subject; for it being an accident common to all Countries, although not very often happening in any one, I ſhould be very glad to make the beſt improvement I could of my preſent opportunity. ——

—— I give you two other Relations, which ſeem to me not common.

A Girle in *Sheffield* about eight months old was ſurprized with violent vomiting Fits, which held her for about a week, and made her ſo weak, that her Parents began to deſpair of her recovery. They at length ſent for Mr. *Fiſher*, who chanced amongſt other things to ſay, *Worm-wood* was good for the Stomach. He going home to fetch things proper on that occaſion, they in the mean time offer'd her ſome Wormwood-Ale, which ſhe took ſo greedily, that ſhe ſwallowed down a pint of it. Mr. *Fiſher* at his return found her vomiting, and ſhe vomited up in his preſence three *Hexapodes*, of this bigneſs and ſhape; (*See Fig.* 2.) all very active and nimble. The Girle in a ſhort time recovered, and was well. Mr. *Fiſher* in the afternoon brought the *Hexapodes* to me; we killed one of them with trying Experiments upon it. I remembring, I had ſeen ſome very like them, which devoured the skins of ſuch Birds as I kept dried for Mr. *Willoughby*, I gave either of the ſurviving *Hexapodes* the head of a ſhining *Atricapella*, which in about five weeks time they eat up, bones, feathers and all, except the extremities of the feathers and the beaks. I deſiring to ſee, what

 they

they would turn into, gave them a piece of *Larus*, but that, it seems, agreed not so well with them, for they died within two daies.

I have often been puzled to give an account of those *Phænomena*, which are commonly called *Fairy-Circles*; I have seen many of them, and those of two sorts, one sort *bare*, of seven or eight yards diameter, making a round path something more than a foot broad, with green grass in the middle; the others like them, but of several bignesses, and encompassed with a circumference of grass, about the same breadth, much *fresher* and greener than that in the middle. But my worthy Friend Mr. *Walker*, a Man not only eminent for his skill in *Geometry*, but in all other Accomplishments, gave me full satisfaction from his own Experience. It was his chance one day, to walk out amongst some Mowing-grass (in which he had been but a little while before,) after a great storm of Thunder and Lightning, which seemed by the noise and flashes to have been very near him. He presently observed a round Circle, of about four or five yards diameter, the rim whereof was about a foot broad, newly burnt bare, as the colour and brittleness of the Grass-roots did plainly testifie. He knew not what to ascribe it unto but the Lightning, which, besides the odd *capricios* remarkable in that fire in particular, might without any wonder, like all other Fires, move round, and burn more in the extremities than the middle. After the Grass was mowed, the next year it came up more fresh and green in the place burnt, than in the middle, and at mowing time was much taller and ranker. Thus far Mr. *Jessops* Letter; I shall only add, that you will much oblige him to assist him with some Queries about the *fulminating Damp* with what convenient speed you can. †

† *Such Queries as are here desired, are already dispatched away, with hopes, they will shortly receive an answer.*

As to the vomiting of strange Worms, I give you a late instance not unlike that in this Letter:

A Son of Mr. *B*, living not far off *Rippon*, about nine years of age, in the month of *February* last was afflicted with great pain in his Stomach, and continual Vomitings. A Powder was given, wherein was a small quantity of *Mercurius dulcis*. He there-

thereupon vomited up ſeveral ſtrange Worms, two of which were brought to me at *York*, the one dead, the other alive, and which lived many daies after it came to my hands, and might have lived longer, but that I put it into Spirit of Wine, to preſerve it in its true ſhape. Theſe Worms were very *Caterpillars* with fourteen legs, *viz.* ſix ſmall pointed, the eight middle ſtumps, and the two hind claſpers; ſomething more than an inch long, and of the thickneſs of a Ducks-quill, thin haired or rather naked, with brown *annuli*, and a black head. The very ſame for kind that I have many times ſeen on Plants, and no doubt, theſe (as thoſe others) would in due time (if the place had not hindered) have ſhrunk into *Chryſalis's*, and changed into Moths. As alſo thoſe mentioned by Mr. *Jeſſop* would have changed to Beetles.

I am,

Sir,

Your moſt humble Servant.

Some Obſervations made in Scotland *by that Ingenious Knight Sir* George Makenzie, *ſent in a Letter to Mr.* James Gregory, *and by him communicated to the Publiſher.*

SIR,

IT were as needleſs as fruitleſs to write a Hiſtory of our Land as to its ordinary qualities, productions, ſcituations, and the like; or of the ordinary methods of manuring it for Corns and Fruits; ſince I know little practiced here, but what is ſo over all the Nation. I ſhall in a ſhort time give you ſome account of ſome *Marcaſites* and *Minerals*, that are found here, after I have given a little time to examine ſome Informations.

Of *Earths* I have little to ſay; only one of our moſt ordinary Soyls for Barley-land, is an Earth digged and mixed with Beaſts-dung: In a place near my dwelling there is a plot of ground, leſs than one Acre, out of which for theſe many years paſt Earth hath been digged for the ſaid uſe; and in two years time it will grow up again, and fill the excavated place, ſo that it continually furniſhes Soyl for the adjacent Lands. An other like this I have in a Farm belonging to my ſelf, twenty miles diſtant from this, of the ſame nature and quality. Both are a ſtiff Clayiſh Earth, of a dark colour and moiſt. Both theſe places I have viewed theſe ſeveral years, and have diſcerned this truth: It will grow a foot high in two years. Nothing makes our Land give greater increaſe of Barley than Sea-wrack (*Alga marina*;) but Lands often uſed to this manure yield but bad Oats, and ſmall quantity, and the husks both of the Barley and Oats that grow on ſuch Lands are thicker than thoſe that grow on other Lands, and theſe grains have alſo greater mixture of darnel.

The Increaſe that ſome places in our Iſles do yield is almoſt incredible, conſidering the Climate and Soyl. For ſome will ordinarily yield ſixteen or eighteen fold, as very honeſt and credible Farmers have often informed me from their continual Experience: And moſt of thoſe Lands, that yield ſo well, are

of

of a very ſandy Soyl, and only manured with Sea-wrack. I have a piece of Land in *Lothbroom-Pariſh*, that yields continually every year plentiful crops of Barley, without ever having ſo much as one load of Manure, or any kind of addition laid on it: And this it hath done paſt memory. I have ſeen the Corn of it ſeveral years; nor doth the Ground grow leſs, nor is it exhauſted by yielding ſuch plenty of Corn and Straw, though it receives no addition. Whether it be, that Rains waſh down matter equivalent to manure from the adjacent Hills (which yet cannot be diſcerned, though looked after;) or whether its fertility proceeds from prolifick exhalations from a ſubterraneous cauſe, I will not determine.

There are alſo ſome Fields, that appear to be nothing elſe but a gathering of ſmall Pebbles, inſomuch that Earth cannot be well diſcerned amongſt them; yet do they yield abundance of good Corn, eſpecially of Barley; and more than contiguous Lands that are not ſtony. Whether this be from accidental Heat contracted by the preſſure of thoſe Stones; or from ſulphureous Salin emanations from them (which yet I could never force out of them;) or whether it be from the repercuſſion of the fermenting exhalations that aſcend, which they force into the portion of Mould that is mixt with them; I leave to the Judicious to conſider.

As for our *Herbs*, I have nothing extraordinary. All I find here, are in Hiſtory, excepting one, which grows on Stony-ſhoars; but becauſe 'tis not by me, I will not venture to give you its deſcription now, leaſt it ſhould be too imperfect. One particular I took notice of, which perhaps is no novelty to you, as it is none to our Highlanders; But ſince it is to me, I ſhall relate it. When they want Ink, they take the Root of the *Iris paluſtris lutea* (*yellow Water Flower-de-luce*) and infuſe it twenty four hours in clear Fountain-water; others boyl it a little: The water will not be tinged to any height. Then they take a rough white Pebble, and rub it continually in the water on a knife or any piece of clean Steel; and in leſs than an hours time the water will become very black, and tolerable good Ink: This I oft-practiced.

Our Forreſters alledge, that when Deer are wounded, they lie on a certain Herb, which grows plentifully in our Forreſts, and

and that by its vertue the bleeding is ſtanched, and the wound healed. I did take a quantity of it, and reduced it to a ſalve, with Wax and Butter. Its effect was that it healed too ſuddenly, ſo that I durſt not adventure to uſe it in any deep wound: But for ſuperficial ſcars it hath a very ſudden operation. At that time I did not know this Herb by any name; but now I find it to be *Aſphodelus Lancaſtriæ verus* of *Johnſton*, or the *Lancaſhire Aſphodil.*

I cannot omit to add here, that 'tis very ordinary to find *Molucco Beans* on the ſhoar of the *Lewes* or other our Weſtern Iſles. They are found faſt to the ſtalks, which the Common-People ſuppoſed to be Sea-tangles, and laughed at me, when I ſaid they were Land-beans: Which made me to write to the Earl of *Seafort*, whilſt he lived in the *Lewes*, that I ſuppoſed, theſe apparent tangles were the ham of the Beans, which by long lying in the Sea might acquire that likeneſs. His Lordſhip examined the matter, and found it ſo. And he likewiſe ſent to me a piece of a *Cabbage-tree*, that was found on that ſhoar. It is obſervable, that the kernel of theſe Nuts will be freſh and ſound, and the people make boxes for Snuff of the Bean-huſk. Now, conſidering the ſcituation of thoſe Iſles with reſpect to any place where *Molucco-beans* grow, let the Obſervers of Tydes conſider, what reciprocations muſt be imagined to adjuſt the Eaſtern and Weſtern conſtant Currents of the Main with the wafting of theſe Beans on places that lie ſo far out of the road of any of the direct Tydes: And if they grow only about the *Molucco*-Iſles, or in no place on this ſide the *Equator*, it would ſeem more probable, that they came by the Northern paſſage, than any other way. And their freſhneſs in the Kernel ſeems rather to have been kept in the Cold conſervatory, than in the Warm Baths of the other progreſs.

Tarbutt, July 9. 1675.

An Extract of a Letter of Mr. Listers, *containing some Observations made at the* Barbado's.

SIR,

A Correspondent of mine at the *Barbados*, the Learned Dr. *Thomas Towns*, hath lately furnished me with some Observations in a Letter of his dated in that Island *March* 26. 1675; which I shall transcribe for you:

1. Our general draught of Wine is from the *Madera*, which, contrary to all other I know of, will not endure a cool Cellar. *French* nor *Rhenish* Wines neither keep nor agree well with our stomacks, if so constantly drank as in *England*. *Canary-wine* few here care for, counting it fulsom, *&c.*

2. For my part, I would wish to live in this Island, as 'tis now setled, before any other place, it being so temperate that we need not hang over the fire to keep out cold, nor shut up doors at noon (as I hear the custome is in *Spain*) nor set our beds in the tops of Houses (as they do in some places on the Mediterranean-Sea) to fence off heat: For the Sun, notwithstanding his neighbourhood, is very gentle here, being fann'd with a constant gale from the East.

3. I have heard it question'd, Whether *America* have not some Plants common with those of *Europe*, especially the more Northern parts of it; and probably supposed, that the tops of Mountains here might produce such, as being cool and somewhat approaching to the temperature of those places in the North, that are level and more forcibly influenced by the Sun. To the clearing of this doubt, I observe, that *Purslane* is here all the Country over where I have been, and even troublesome to the Planter: In the fields I have many times gathered a Sallat of it, and it eats as well with Oyl and Vinegar as that of our *English* Gardens. Here is likewise a *Sonchus*, *Lens palustris*; I found also a *Melilot*, or one so like it in all circumstances (except that the branches are not so erect) that I cannot find any difference from that of *England*.

4. Thee

4. The Springs here are all near the Sea, ſo that thoſe who live up in the Country have no benefit of them. They made Ponds formerly to receive Rain; which ſerved well enough, being kept cool by a *broad leav'd Weed* and *Ducken meat*, which over-grow moſt Ponds. But now almoſt every *Sugar*-Plantation hath a Well, that gives very good Water.

5. The Soyl is fertil, though not above a foot or two thick, upon a white and ſpongy Lime-ſtone-Rock, which affords good Quarries here and there, that ſerve for building. Every Dwelling-houſe, with the Sugar-work and other Out-houſing, looks like a handſome Town; moſt being now built with Stone, and covered with Pan-tile or Slate (brought hither in the ballaſt of Ships, as are likewiſe Sea-coal for Forges, and ſo are brought cheap enough.) Indeed the whole Iſland appears in a manner like a ſcatter'd Town, which with the perpetual green Fields and Woods makes the place very pleaſant.

6. The Blood of *Negro's* is almoſt as black as their skin. I have ſeen drawn forth the Blood of at leaſt twenty, both ſick and in health, and the ſuperficies of it all is as dark, as the bottom of any *European* Blood, after ſtanding a while in a diſh. So that the Blackneſs of *Negro's* is likely to be inherent in them, and not cauſed by the ſcorching of the Sun, eſpecially ſeeing that other Creatures here, that live in the ſame Clime and heat with them, have as florid Blood as thoſe that are in a cold Latitude, *viz. England*: Though much farther to the North there are People, that cannot brag of much clearer skins than the *Europeans*; ſo that Complexions are no leſs Cold-burnt (if I may ſo phraſe it) than Sun burnt.

An Account of ſome Books.

I. *Marcelli Malpighii ANATOME PLANTARUM; cui ſubjungitur Appendix, iteratas & auctas ejuſdem de OVO INCUBATO Obſervationes continens.* Londini, *Impenſis* Joh. Martyn, *ad inſigne Campanæ in Cæmeterio D.* Pauli, 1675. *in* fol.

THe Excellent Author undertakes in this Treatiſe to exhibit the Inward ſtructure of Plants both by Diſcourſe and Scheams, according to the Obſervations, himſelf hath made thereof by a Microſcope; with a deſign, thereby to diſcover the cauſes of the ſeveral appearances, qualities and effects of Plants, as they may depend upon the various Poſition, Size and Shape of their parts, and upon the different ways of Percolation, Fermentation, and the like operations in the ſame.

He begins with the *Bark*, and proceeds to the *Woody part*, and the *Knobs*, and ſo on to the fabrick of the *Buds*, *Bloſſoms*, *Leaves* and *Seeds*: Promiſing at the end to prepare another Work about the *Roots* and *Excreſcences* of Plants; that ſo, having ſurveyed and well conſidered the Hiſtory and matter of fact, he may proceed to make an Eſſay of what is thence deducible touching the Cauſe and Manner of *Vegetation*.

Concerning the *Bark*, he finds it to be made up of ſeveral parts, of which the prime ones are thoſe he calls *Ligneous* or *Woody fibres*, in his opinion analogous to *Nerves*, which he ſaith are pipes pervious to a clear liquor; the ſtructure of which Pipes conſiſt in many ſquare partitions, opening into one another. Theſe veſſels he finds to lye neither ſtraight nor parralel, but to be for the moſt part compacted like little fagots; of which ſome do make a kind of Net-work, whereby the Bark becomes to be an aggregate of reticular coats, ſurrounding the Woody part of the plant: And as to what paſſes through them, he ſaith, that the Juyce being entred into them, is, by the heat of the Seaſon ſtriking upon the Soyl and forcing up the liquor, made to aſcend a little way; and then by the ſurvening night and cold ſtopt for the time, but is again, by

the heat of the next day, ſending up more Juyce, thruſt up higher from time to time, till it gets to the top, climbing thither as 'twere by ſteps: To which aſcent it is marvellouſly aſſiſted by the ſtructure of theſe Pipes, being divided into ſquare partitions, opening into one another, and furniſh'd with ſomething that performs the part of Valves, endowed with a Spring.

From theſe Pipes, he ſaith, do depend and break forth Horizontal ranks of Baggs or *Bubbles*, croſſing thoſe Fibres; into which bubbles the aſcending Juyce, like a chyle, is diſcharged, and being ſtay'd there a while, and mixed with the old Juyce there reſiding, comes to be fermented, and advanced to the nature of an Aliment: Whence it comes to paſs, that in many of thoſe Bubbles there fall out due precipitations of a tartareous matter, which is condenſed and hardned in theſe veſſels. And 'tis in theſe Bubbles, ſaith he further, that much of this Juyce is digeſted, which afterwards is diſtributed to the Woody, and other parts of the Plant.

But, beſides this preparation of the Aliment made in the *Bark*, there is another office, which that part ſeems to be appointed for; and that is the increaſe of the bulk of Plants, by adding yearly a coat or ring of Fibres, which being interwoven by theſe Horizontal ranks of Bubbles, and by degrees conſolidated and hardned, do put on the nature of *Wood*.

The *Stem* or *Trunck* of Plants conſiſts, according to him, of *Ligneous fibres*, tranſverſe *ranks* of *Bubbles*, and *Air-pipes*. In young Trees, he ſaith, the ranks of theſe Bubbles paſs into the very Pith; which pith is abounding in young Twigs, until by the growth and hardning of the ligneous fibres it waſtes away. Now the clear Juyce, which through the Woody filaments riſeth up into the ſtem and branches, is diſcharged into the lateral appendages of the Bubbles, and there advanced, as hath been ſaid already, into a nouriſhing Juyce: And as in Animals the new Aliment enters under the form of Chyle into the Veins, where being mingled with the old blood, which is endow'd with ſeveral ferments, as the *lympha* and others, and ſo circulated into the habit of the whole body, it enters into all the parts of it, in which it meets again with determinate ferments raiſing them to the peculiar nature of every part, tranſpiring

tranſpiring and precipitating what is uſeleſs; *ſo* in Plants the Juyce, conveyed through the ligneous pipes, is carried to the old Juyce harbour'd in the ſaid Bubbles, and is there and in the Pith fermented and further prepared, and kept to furniſh matter for future Buds and Leaves.

The *Air-pipes*, called alſo by him *Spiral fibres*, are, in his opinion, a kind of Silver-colour'd plate, wreathed ſpirally, and ſo conſtituting an open hollow pipe, of a ſcaly texture, made up of little pipes and bladders, very like the Lungs of Inſects, admitting contraction and dilatation. Whence he concludes the great neceſſity and uſe of Air and Reſpiration in all thoſe Creatures that have even but the leaſt degree of life: Which Air, he ſaith, is in Plants taken-in chiefly by the Root out of the Earth, there being no ſuch conſpicuous Air-pipes in the Bark or Leaves, whereas the Roots are exceedingly ſtored with them. This Air, contained in theſe pipes, and ſubject to compreſſion and rarefaction, preſſes by its ſwelling upon the contiguous Woody fibres and their adhering bubbles, and ſo ſqueezes out their Juyce into the neighbouring parts; which being relaxed and emptied, they admit and take in freſh liquor.

Such Plants, as inſtead of *clear* liquor contain in their fibrous pipes a *colour'd* Juyce, have a peculiar veſſel, as in the *Ebulus* (*Dane-wort*) fig. 30, and in all Lactiferous and Reſinous plants, fig. 31. And each Plant ſeems to our Author to have a peculiar veſſel to contain and prepare the laſt and ſpecifick nouriſhment for that plant; ſuch as are thoſe, that hold the Turpentine and Rozin in ſome Trees; there being as many ſeveral ſorts of Juyces as there are *ſpecies* of Plants, and therefore peculiar Veſſels, preparing the laſt and proper juyce for each reſpective Plant.

The *Stems* of Trees and their Branches *increaſe* by the external addition of a new Coat of Fibres and Air-pipes, growing about them every year, and thereby giving them a new Ring of wood.

As to the *Knobs* of Plants, they are to our Author nothing but the productions of new Off-ſprings upon a new implication of Fibres and Air-pipes, for the ſhooting out of new Leaves, and young Sprouts or Buds.

A *Bud* is, as 'twere, the new *Fœtus* or birth of a Plant, or a Sprout contracted in ſmall, incloſing a tender woody part (raiſed from ligneous fibres and medullar bubbles) and the rudiments of the Leaves. Here our Author takes notice, that Nature, in ordering the ſeveral kinds of *Living* things, conſtantly proceeds in almoſt the ſame, or at leaſt in an analogous, method: Conſidering, that in *Animals*, that are called perfect, ſhe raiſes them from Eggs by a continual augmentation and nutrition to their due magnitude, joyning from time to time new particles to the former; yet ſo, that in every ſtate of increaſe, that form, which was firſt of all in being, is ſtill maintained, no part emerging anew in the Animal but Teeth and Horns; whereas in *Inſects*, beſides the increaſe, there come forth parts, whoſe rude lineaments lay hid before, in the Infancy of thoſe Creatures; ſuch as are Wings, Feelers, and the like: And to *Plants* ſhe gives a daily increaſe by inveſting the trunk and branches with a Woody ſupercreſcent Coat, but ſo, that from the tender Branches there ſpring forth every year young ſprouts out of a precedent bud. And *as* in a Caterpillar the rudiments of ſome parts, being yet fluid, lye a pretty while concealed in little bags, until by the repoſe of the Inſect, under the form of an *aurelia*, they grow and come forth more ſolid; *ſo*, ſaith our Author, the parts of a Branch lye at firſt hid in the bud, till afterwards being enlarged by the moiſture and warmth of the Spring, they extend themſelves into the form of a Sprout.

The *Leaves* are, to our Author, a conſiderable part of the Plant, ſeeing that all thoſe parts, that are wrapt up in the ſtem or trunck, do, when opened in the extream and younger parts, break out into Leaves; ſo that theſe ſeem to be nothing but appendances to the Trunck lengthned and opened; the ligneous Pipes and Air-veſſels, derived from the midſt of the Woody cylinder of the tender Ring, running together into a bundle, and forming the Stalk, and at length upon their dilatation compleating the Leaf. The great variety of Leaves our Author deduces from the tranſverſe ranks of Bubbles appendant to the woody pipes of the Stem, upon the opening of the Stalk.

The *Office* of the Leaves ſeems to him very conſiderable, foraſmuch

forasmuch as, in his opinion, they perform the part of the *Skin* in Animals, which in them is so made up of Nerves, Veins, Arteries, Lympheducts, Tendons, and Glandules, that the nourishing Juyce, by small passages conveyed into it, acquires a new texture and a new kind of fluidity, whereby what is useless is separated, and the rest, being returned into the inner habit of the Animals body, nourishes and repaires it. Thus, saith he, there are found in *Leaves* all the sorts of Vessels to be met within the body of Plants, as Air-vessels, Woody-fibres, and Vessels of Transpiration. This he illustrates by Observations taken from Insects, and upon whose skin abundance of moisture gathers together; they also frequently casting their skin, as Plants do their leaves. This opinion of his, *viz.* that the Nutritious Juyce is further concocted in the Leaves, he endeavours to render more probable by the consideration of the little Seminal Plant, which contains two Leaves; insinuating also, that from the Leaves there is a regress of the concocted Juyce into the stem, and consequently a peculiar circulation.

But to proceed; our Author esteeming the Branches to be produced for the generation of the Vegetable Egg, he teaches, suitably thereunto, that a *Blossom* or *Flower* is, as 'twere, the *Uterus* together with the Egg or *fœtus* of the Plant, which in due season is exposed to the Air, to make it grow at length into a new Off spring. In explaining the manner of the production of *Flowers*, and their variety, he is very curious; as he also is in that of *Seeds*; which latter he observes to be lodged in divers Cases or Caskets, performing the office of an *Uterus* and the parts thereof. And seeing the *Seed* grows in very many Plants to an edible *Fruit*, he describes the structure and parts of several Fruits, viz. *Figgs*, *Cherries*, *Grapes*, *Pears*, *Citrons*, *Limons*, *Oranges*, *Gourds*, *Straw-berries*, *Nuts*, *Almonds*, *Acorns*, *Chesnuts*, *Legums*, *Corn*, &c. taking notice of the singular *apparatus*, formed by Nature for the sake of the *Seed*, which he calls the *Fœtus* and the true compendium of a Plant, made up of all the principal parts thereof. Upon all which he enlarges with great accurateness.

But his Observations about *Galls*, and other Excrescences and Appendages of Trees, he reserves for another Discourse

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(which we have reaſon to expect wirhin a little time;) yet noting here in ſhort, that thoſe Excreſcences are not the *Wombs*, in and by which, Trees and other Plants produce Inſects; but only the Neſts of the Egg caſt there by the Animal parent, and not at all furniſh'd by the Plant it ſelf.

As to the *Uſe* of the parts of Plants, eſpecially the paſſage of the Aliment, he is very ſparing, and modeſt in giving his opinion about it, judging it difficult not to miſtake herein. Mean time, he interſperſes, in the Explication of their ſtructure, his thoughts concerning it, having well conſidered the diverſity of Veſſels in Plants, *viz.* the great number of pervious Fibres in the Bark, the abundance of other Fibres in the Ligneous part, ſome of which are compos'd of a Spiral zone, others made up of roundiſh Bubbles, opening, as 'twere, into one another; there being alſo a peculiar veſſel, that yields Milk or Rozin.

Thus far of our Authors ANATOME OF PLANTS: Touching his *Appendix* of *Incubated Eggs*, he therein ſhews, with what care he hath repeated his former Obſervations upon that ſubject*; though he ſtill ſcruples to determine, which of theſe two, the *Heart* or the *Blood*, hath the priority of exiſtence in the Formation of a Chick: This only being certain to him, that there may be obſerved the *prima ſtamina* or firſt lineaments of the Chick even *before* Incubation, and that afterwards, *by vertue* of the Incubation there are firſt manifeſted the *vertebræ*, and the beginnings of the Brain and the Spinal marrow, together with the Wings, and ſome Fleſh; the Heart, Veſſels, and Blood yet lying then concealed: But yet, becauſe that ſome rivolets do appear in the umbilical *area*, he thinks it probable, that the Heart is then alſo appendant to the *carina* of the Chick, he having ſeen the Heart before the thirtieth hour: But 'tis a conſiderable time, he ſaith, before the Liquor paſſes through the Heart and the Veſſels; which Liquor he hath obſerved to be firſt of a yellowiſh, then of a ruddy, and at laſt of a Blood-red colour. Whence he again offers his conjecture, that the Liquor, the Veſſels and the Heart do exiſt *before* the Blood.

* *Theſe were alſo dedicated to the* Royal Society, *and by their Order printed* A. 1673. *by Mr.* John Martyn.

II. *Epiſtola*

II. *Epistola ad D.* Joelem Langelotum *de* ALCALI & ACIDI *Insufficientia ad gerendum munus Principiorum Corporum naturalium: Conscripta à* Joh. Bohn *Phil. & Med. D. in Acad. Lipsiensi. Lipsiæ, A.* 1675. *in* 8°.

IN this Epistle, as the Author declareth himself highly dissatisfied with the *Peripatetick* and *Chymical* Elements of Bodies natural, and affirms the Weakness of them to have been sufficiently laid open, and chiefly by the Experiments of those two great English Philosophers, *Bacon* and *Boyle*†; so he undertaketh to prove the Insufficiency of that lately celebrated *duumvirat* of Principles, the *Alcali* and *Acid*, by the congress and conflict of which the Maintainers of them presume to give an account of all the *phœnomena* of Nature.

† *The latter of which hath ready for the press a Discourse of the same subject with this Epistle; which he was pleased to give a perusal of to the Publisher, before he would cast an eye upon this piece of our Author.*

This Undertaking of our Author is here performed, 1. By representing the Obscurity of these two Principles: 2. By examining some Instances in which they are alledged to perform all the effects thereunto belonging. 3. By shewing the Necessity of at least one Principle more, as active as any of those two.

The *first* of these he endeavours to make out by taking notice in the *first place*, that as yet we have not so much as competent Definitions of an Acid and Alcali, and that those which are taken from our Senses are unsatisfactory for explaining the inward constitution of Bodies; there being some substances endow'd with certain vertues or powers not discernable by any of our senses, and the Acids and Alcali's being capable of being reduced into such minute particles, as also of being sometimes thus dissociated by mixtures, that the Tast shall not at all be able to discover them, and that even in such Concrets, whose activity depends from one or other of those Principles.

Next, he considers, that that affection, which is ascribed to these Salin Principles, namely, their mutual Effervescence, is

is not of that latitude, as to explicate by it *all* the phænomena of Nature, though he denies not, that by means of their powers very many effects, and those admirable ones, may be explicated, such as are solutions, precipitations, distillations, sublimations, calcinations, &c. But that *all* cannot be by such a reaction accounted for, he instances *first* in the known vertue of Alcaly's upon Mineral Sulphurs, such as Salt of Tartar or fixt Nitre and Common Sulphur, which may be reduced into white powder, out of which may be extracted a Tincture as well by these fixt Salts, as by the volatil ones of Sal Armoniac and Harts-horn, and by their means a Sulphur out of Antimony; yet *without* any sensible effervescence, even when they are prepared in *formâ humidâ*. *Secondly*, he instances in divers Rozins dissolved by the Whites of Eggs without any observable Effervescence, and in Turpentin dissolving several Gums without any commotion. To these he adds the Instance of the Coagulation of Quick-silver by the fume of melted Lead, without any reaction of an Acid and Alcali, that is perceivable.

Besides, he observes, that 'tis doubtful, whether all those Substances that do tumultuate with an Acid, are Alcaly's, or that do boyl up with Alcaly's, are Acid. For 1. *Acids* do boyl up with *Acids*, and mutually render turbid and do precipitate their Solutions; as Spirit of Salt or Vitriol works upon the Solution of Silver or Copper made by *Aqua-fortis* or Spirit of Nitre; as also Spirit of Vitriol, and Spirit of Salt heats, and turns into a whitish *Offa*, by a Solution of Saturn, made with distilled Vinegar; And *Aqua-fortis* and Spirit of Nitre, though they make no sensible ebullition in the said Liquor, yet they cause the particles of Saturn to subside at the bottom in the form of a whitish powder.

Moreover, he notes, that an Acid is put into commotion by that which is neither an Acid or Alcaly; as Oyl of Vitriol ming'led with either common or distilled Water, and likewise with spirit of Wine and oyl of Turpentine.

Again, he finds also, that neither all what boyls up with an Alcali, or receiveth it into it self, is therefore presently to be taken for an Acid; because the liquor of Nitre fixed by coals, and Oyl of Tartar, do as well as juyce of Citron, Vinegar, &c.

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ſeparate the parts of Milk; which, he ſaith, he hath alſo often ſeen done by putting Gall into Milk.

Having diſpatcht theſe particulars, he proceeds to ſhew *ſecondly* by divers Inſtances, that many effects are commonly aſcribed to Acids and Alcaly's, which are not due to them, becauſe they are either not at all to be found in thoſe bodies, whence ſuch effects proceed, or not in that quantity, which is neceſſary to maſter and ſubdue the power of the other parts of the Concret.

Laſtly, to evince, that there is at leaſt a *third* principle in Concrets, that hath as great a power to act, as thoſe two; he inſtances in the Amalgamation of Gold and other Mettals, that is performed with Quick-ſilver, which is ſo mixed with them *per minima*, that they are changed together into an unctuous maſs; whereupon, the Mercury being ſeparated again, either by paſſing it through Leather, or by diſtillation, or by flowers of Sulphur kindled, the Mettals appear again in the form of a very ſubtile *calx*. But now, that there ſhould proceed from Mercury, or any Acid ingredient thereof, a calcining power, the known effect of Acids being Corroſion, our Author cannot aſſent to: Eſpecially ſince, as he affirms, Mercury highly rectified and freed from all its acidity, retains notwithſtanding its former amalgamating and corroding vertue.

What this *third* ingredient of Concrets ſhould be, our Author thinks difficult to determine; he offers only to call it the Sweet and Inflammable Principle in Combuſtible bodies: Yet would not be underſtood to eſteem it a Catholick principle, nor to exclude a fourth or more Principles. All which he concludes with a diſcourſe tending to evince, that the Inflammability of Bodies depends not upon their Acidity.

IV. Zymologia Chymica, *or a Philoſophical Diſcourſe of* Fermentation, *from a New Hypotheſis of* Acidum *and* Sulphur; *With an additional Diſcourſe of the* Sulphur-Bath *at* Knarſbrough: *By* W. Sympſon *M.D*, London, 1675. *in* 8°.

THe Learned Author, not being ſatisfied with any thing he had yet ſeen extant upon this argument of *Fermentation*, propounds in this Tract a New *Hypotheſis*, as an *Eſſay* towards the further improvement of that noble Doctrine; endeavouring to ſolve, from the inward conflicts of *Acidum* and *Sulphur*, the phænomena of all *Hot-Baths*, the generation of *Minerals*, the production of many *Spaw-waters*, the grand appearances of *Heat*, *Fire* and *Light*; as alſo various other Subterraneal phænomena, as *Damps*, *Earthquakes*, *Eruptions*; likewiſe the appearances of *Meteors*, and divers other both remarkable and entertaining effects.

In the doing of this he *firſt* explains, what he means by *Fermentation*; and *ſecondly* ſets forth the large extent thereof in the whole orb of Nature.

He defines *Fermentation* to be nothing elſe but an inteſtine Colliſion betwixt *Acidum* and *Sulphur*, put together by Nature or Art, and ſet into a combating motion, in order to the production of Concrets, or to ſome other equivalent end.

This definition he applies *firſt* to the productions in the *Mineral* kingdom, undertaking to ſolve from thoſe two Principles the phænomena of *Hot-baths*, and the production of *Minerals*, and other ſubterraneal appearances. Where he laies down two poſitions, whereof one is, that there is no *Hot-bath* without *Sulphur*; the other, that an *Acid* is neceſſarily requiſite in all *Mineral* fermentations: Declaring withal, what he means by *Sulphur*, and how *Hot-baths* differ chiefly according to the difference of their *Sulphurs*; and which of them are ſafely, or not ſafely to be taken *inwardly*: Endeavouring alſo to ſhew, how from the principles ſpecified, put into fermentation, the waters paſſing through them muſt neceſſarily become *hot*; confirming this by an induction of Experiments, ſhewing, how *Sulphur* by Fermentation becomes to be comminuted,

nuted, volatilized, and made capable of Solution in *Water*, as happens in all Baths: All which he illuſtrates by a Parallel betwixt *Mineral* and *Vegetable* Fermentations; eſteeming, that Vegetation is nothing but a natural ſlow-paced Fermentation from each Plants peculiar principles of Acid and Sulphur.

In this part he examines and diſallows both *Tachenius* his Hypotheſis of *Acids* and *Alcaly's*, and the Cauſe aſſigned by divers Authors of the *Heat* in Natural Baths, *viz. Subterraneal fires*; and withal removes the grand Objection alledged againſt *Sulphurs* being the cauſe of Heat in Baths, *viz.* that if *Sulphur* can give actual heat, it muſt burn; aſſerting, that Sulphur may be one of the efficients of Heat in Baths, and yet its *flagration* not requiſite at all.

Diſcourſing of the *Acidum*, as the other cauſe of all Mineral Fermentations, he declares, that he means here by *acidum* either ſuch as is inbred in the ſame Mineral concretion, whilſt in *ſuccoſoluto*, in the beginning of its generation; or an extrinſick ſupervening one, which is powerful in the reduction of Minerals already ſolid and compleated. This done, he proceeds to prove, that there are Acid juyces in the bowels of the Earth, and that theſe are either embryonative to the ſame Mineral where the Sulphur is, or elſe peculiar to ſome other body by which the tranſient Waters become acuated.

Explaining, *How* the waters in *Hot-baths* become hot, he endeavours to ſhew, *firſt*, that ſome ſorts of *Acids* have ſo powerful an operation upon *Sulphurs*, as that being put into motion they are ſufficient cauſes of fermentation in Mineral Juyces; and *next*, that *heat* is the neceſſary and immediate reſult of ſuch fermentation: Where he takes notice, that the fermentation, made betwixt *Spirit* of *Nitre* and *Butter* of *Antimony*, is not from the *Salts* in the ſublimate mixing with the Acid in the diſſolvent, becauſe, *ſaith he*, the ſame, poured upon the ſame Salts while incorporated with *Mercury* in the form of Sublimate, cauſeth no ſuch fermentation; yea, he affirms to have ſeen Sublimate, wherein the aforeſaid Salts that are in Butter of Antimony are lodged, diſſolve in an *acid*, without the leaſt ſenſible ebullition, near as ſoon as Ice in warm water. To this he adds, that 'tis *water* that ſets the *inbred* principles of *acidum* and *ſulphur* into a greater inward commotion, and makes the fermentation the

ſtronger, and conſequently the *heat* greater; witneſs that a little water, put to *Oil* of *Vitriol*, preſently ſets the fermental principles of acidum and ſulphur, connatural to that Oil, into a ſtrong ebullition, whence reſults ſo great a heat, as the glaſs, 'tis done in, can hardly be endur'd by the hand, eſpecially if the Oil be well rectified; which he confirms by the Obſervation of good Authors, aſſerting that in many places *Mines* are found ſo hot, that they can hardly be touch't: As the *Mineræ* of *Allom*, or *Vitriol*, being broken and expos'd to the Air, contract ſo ſtrong a heat, as ſometimes to cauſe an actual ignition, by which (he ſaith) not long ſince a *Barn* at *Yeeland* near *Halifax* was burnt.

Having thus deliver'd his *Hypotheſis* of the cauſes of *Hot Baths* from the fermentation of mineral Juyces, cauſed by acids and ſulphurs, he goes on to ſolve from thence various other ſubterraneal Effects, ſuch as are *Damps*, *Poyſonous Springs* and *Lakes*, as alſo thoſe of *Earth-quakes*, *Eruptions*, *Concrete Sulphurs*, *Spaw-waters*; concerning the laſt of which he ſaith, that where there is a current of water irrorating ſome Earths or mineral beds of Iron or Alom-ſtone, there are made Vitrioline or Aluminous Spaws. Hence he deſires his Reader to conſider, whether from the ſame ſuppoſition of cauſes may be ſolved the *diverſity of Winds*, the *viciſſitudes of Heat* and *Cold*, the appearances of *Meteors*, *Snow*, *Hail*, *&c.* He offers alſo, from the ſame principles to explain the two great phænomena of *Heat* and *Light*, found in concrete bodies; yet leaving it to further examination, whether in that great Fountain of Light, the Sun, its perpetual emanation of Light may not conſiſt in a peculiar fermentation of its own, ſet a work by the Creator, and kept a foot by a continual circulation of Ethereal matter: Endeavouring in the mean time to ſhew, 1. How *Heat* is produced from fermentation in all ſuch bodies where 'tis found. 2. How from the ſame Principles of Acid and Sulphur *Light* is made. Where by the by, he labours to prove, that the Fermentation in Mineral Juices, whether natural or artificial, proceeds not from the *Contrariety* of *Salts*, becauſe there is no ſuch ebullition among Salts, but what is from the conflict of Acids and Sulphurs, whereas it never yet could be made appear (*ſaith he*) that theſe minerals contain'd any ſort of *Alcalies*, either fixt or volatile, though it be certain to him from irrefragable experiments, that *Sulphurs* and *Acids* are ſeparable from them

them all. And as he ſhews this in *Minerals*, ſo he undertakes to do it in the Fermentation of *Animals* in all the degrees of digeſtion made in their bodies; deriving alſo thoſe ſpurious fermentations of the Blood, that cauſe Feavours of all ſorts, from *Acids* not congenial, but wholly diſagreeable, and heightening the natural gentle fermentation to an inflammation of the blood and other Juices: aſcribing likewiſe all the *poyſonous properties* of Venemous Animals to the invigorated ferments of their juices, raiſed to that height, as to become poiſonous fire, which by a bite or ſting getting admiſſion into the blood of a human body, will, according to their ſeveral degrees, in their paſſage bear down and mortifie the ſpirits thereof. Whence he endeavours to give an account of the effects of thoſe *Fiery Serpents*, we read of in Holy Writ, and of that matter called *Gecco*, vomited by ſome ſort of venemous creatures, upon their being whipt and hung up (which exaſperates their ferments;) which matter is uſed by ſome *Indians* as a ſpeedy death to their Malefactors, by pricking the skin under a nayl of the hand, and applying a little quantity thereof to it, which immediately getting into the blood, preſently ſuſpends the natural fermentation thereof, and mortifying the ſpirits, kills preſently.

Having ſhew'd this in *Minerals* and *Animals*, he attempts alſo to verifie it in *Vegetables*, *viz.* that *Vegetation* is nothing elſe but a gentle colliſion of the Vegetable Acid and Sulphur in every ſeed, after the looſening of the body in the Earth; which ceaſeth not, till the body, ſhap'd according to the form of thoſe minute types wrapt up in the ſeedlings, and often viſible by Microſcopes, is in all its pourtrayings brought upon the viſible ſtage of the world. And from ſuch a fermentation he would alſo deduce the *Colors*, *Sapors*, *Odors* of Vegetables, and their *Medicinal* qualifications, and their *Propagation by ſeeds*; as alſo the reduction of Corn, Grapes, Fruits, &c. into Bread and Drink; obſerving, that if the acidum of Paſte, Muſt, Wort, or the like fermentable liquors, be by the addition of any other thing precipitated, alter'd, or mortified, then will thoſe liquors never ferment; ſince that Quick-lime, Coral, Crabs-eyes, or any ſort of *fixt Lixivial Salts*, being added thereto, before it begin, will prevent, or, if while fermenting, will ſtop the fermentation.

He proceeds to explain, that the moſt violent of *Fires* is no other than this *Fermentation* in the moſt rapid manner, the ſaid Principles furiouſly driving up each other; alledging, for the evidencing hereof, the Experiment of taking of Spirit of Venice *Turpentine* four ounces, and of *Aqua-fortis* ſix ounces, both recently drawn, which, being mixt together in a Glaſs-viol, will preſently fall into a furious fermentation, ariſing to that height, as actually, among the thick fumes, to burn and blaze out of and above the outſide of the Glaſs in a viſible flame. And thus he wou'd have all *actual Flagrations*, whether from the violent aſſaults of fiery Acido-ſulphureous Liquors (as in the newly recited Experiment) or from *Acids* and *Sulphurs*, ſet into inteſtine conflicts in combuſtible concretes, (as in all uſual *fire*,) to be no other than his deſcribed Fermentation in a moſt violent hurry, the principles acting furiouſly upon each other; whilſt other *ſlower fires* are maintained by ſlighter and more *gentle touches* of the ſame principles.

And as to thoſe Fermentations, that are ſaid to be made betwixt *Acids* and all kinds of *Alcaly's*, whether lixivial or alcaliſate, fixt or volatile; the heat alſo cauſed from the attrition or colliſion of ſolid and hard bodies; our Author is of opinion, that thoſe fermentations are referrable to his principles, and that upon a double account; either, that Acids, when mixed with theſe Alcaly's, do meet with the *Sulphur* cloſe bound up with the *Acid* and Urinous ſpirit or Salt in the *compages* of the Alcali, and ſo cauſe an ebullition; or that they meet with the volatile urinous Salt cloſe riveted with the Sulphur and acid, and ſo cauſe an efferveſcence. Where yet he ſhews the difference, that is to be noted in the Fermentations made between Acids and Sulphurs as they happen in Petrifick concretions and fixt Lixivial Alcaly's, from thoſe that happen in the general courſe of Nature, among Animals, Vegetables and Minerals. To which he adds an account of the fermentation in *Quick lime* upon the effuſion of water, and how that the *acidum* in that ſubſtance ows its original to no other than that of the Fire, contracted in the calcination of the ſtone, and was not præexiſtent *before* calcination. To which power of the *acidum* in Quick-lime, communicated thereto by Fire in the calcination, our Author imputes it, that the *Water* of *Lime*

will

will perform what other more usual Acids cannot: *E. g.* that *Lime-water* mixed with any *volatile Urinous Salts*, and distilled there-from, fixes the Salt, and even turns it into an insipid powder, or indissolvable calx, &c. After which, he spends a Chapter in explaining, how the Heat and Ignition, which is caused from the Collisions and Attritions of *hard* bodies, may be easily solved from the Principles delivered by him.

And having run through the Causes of *Heat* and *Fire*, as the result from all sorts of Fermentations, and shew'd, *Heat* to be Fire in a remiss, and *Fire* Heat in an intense, degree, as also, that these Fermentations proceed from a conflict of *Acidum* and *Sulphur*, excepting those made from an intestine combat of an *Acid* and a fixt *Alcali*, or an *Acidum* and *Urinous spirits*; he comes to explain, How from his doctrine of Fermentation may be solved that grand phænomenon of *Light*; and *first*, the Light from *Culinary-fire* or ordinary combustible concretes, put into that rapid fermentation we call *Fire*: *Next*, the Light of all *Sulphurous matters*; whether in the dry form of *Mineral sulphurs*, *resinous Gums*, *Turpentine*, *Axungia's*, *&c.* or in Liquids, as *Bitumens*, *Oyls*, *Vinous spirits*, *&c*: Then, the Light of *rotten Wood*, *long-dried Fish*, *Gloworms*, *Cats eyes*; as also that from *Attrition of Wood*, and of *Steel* and *Flint*; from the *friction* or *combing of Animals*; and likewise the Light of *subterraneal Lamps*: Upon which last Head he somewhat enlargeth by discoursing of the possibility in nature of such a kind of Fire, that may be maintained and perpetuated *without* Air; affirming, that himself hath seen a Flame or Fire in the cavity of a Glass, which as soon as the stopple was taken out, was (contrary to all other fires) immediately extinguish'd. To which he subjoyns an explication of the Light of some *precious Stones*, the *Bononian stone*, and likewise of *Meteors*; all which give light in the Air not illuminated by any light from the Sun, but by an excitation of their intrinsick Ferments, setting aboveboard their inside *tepor*.

He concludes the whole, *partly* by confirming his Principles from collateral authority; partly by shewing, How that all manner of *Coagulations*, *Congelations*, *Condensations*, *Salifications*, *Petrifications*, and all sorts of Concretions of bodies (or of Juyces into bodies,) are primarily ascribable to *Acids*; and that by

by these Concretions the connate *Acidum* so combines with the *Sulphurous* parts it closeth with, as that both pass into a *tertium quid*, or neutral result, partaking of both, and yet distinguishable by neither; insomuch that the *Acidum* by such sort of coagulations and concretions looses its sting, and becomes altogether unperceivable: Whence he draws the reason, why, though *Acids* be the very foundation of all coagulations and concretions of bodies, yet are themselves to our taste in many things the least discoverable: Which particular he endeavours to make out by *artificial* mixtures, resembling the *natural*, seeing we cannot easily get to the insides of bodies in their natural productions.

As to his discourse of the *Sulphur-Bath* at *Knaresborough* in *Yorkshire*, concerning its *Causes* and *Vertues*, we shall refer the Reader to the Tract it self.

Errata in *Numb.* 116.

In the Contents l. 5. r. *bleak* for *black*; noting the same p. 357. l. 4, and 23. p. 357. l. *numb.* 179. for 176, p. 360. l. 6. r. *triture* for *mixture*, p. 362. l. 15. r. *take the better.* ibid. l. ult. r. *work*, p. 363. l. 21 r. *walking speed*, ibid. l. 29. r. *from the steepest.*

N.B. in *Numb.* 112. p. 273. l. 3 and 4. read, *is by the Cycloid:* which, upon a fresh perusal of that *Extract*, we took notice of, though too late.

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PHILOSOPHICAL TRANSACTIONS.

October 25. 1675.

The CONTENTS.

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A ſummary Relation of what hath been hitherto diſcovered in the matter of the North-Eaſt paſſage; communicated by a good Hand.

IT is ſufficiently known to thoſe who have made any inſpection into the Navigation of this and the former Age, how ſtudiouſly and ſollicitouſly the Lords of the *United Netherlands* have, for theſe eighty years and more, laboured to encourage thoſe that ſhould firſt diſcover a more compendious and ſhorter paſſage by the *North* to *China, Japon,* and other Oriental Countries.

But thoſe who firſt adventured upon this Enterprize, found by ſad experience, that the ſucceſs anſwered not their expectation and hopes: whoſe calamitous encounters I ſhall not go about to recite, ſince their own Narratives have run through moſt hands.

Thoſe who immediately ſucceeded them in that adventure, were not much more ſucceſsful for treading the ſame ſteps that the former had done, becoming involved in the ſame difficulties: For they were miſ-led by an opinion, that that part of the Sea which lieth betwixt *Nova-zembla* and the Continent of *Tartary*, had been paſſable, and that they might have ſailed through that to *China*: But it is now well known to the *Muſcovites* and others, that *Nova-zembla* is no Iſland, but a part of *Tartary*; to the Eaſt-ſide whereof it is annexed by a large neck of land: Inſomuch that the arm of Sea, into which men paſs through the Straight of *Weygatz*, is not truly Sea, but a Lake of *freſh* waters *; the great abundance of Rivers, which out of *Aſia* empty themſelves into this Gulf, occaſioning this Freſh; ſo that it is not to be counted ſtrange, if, eſpecially in the Winter ſeaſon, theſe waters are ſtrongly bound up by the froſt.

**Compare herewith* N. 101. *of theſe Tracts, where you will find a true and full Deſcription of the figure and poſition of* Nova-zembla.

Nor ought any man to wonder, why the Navigation of *William Barentz* (otherwiſe a well-experienced Mariner) was unſucceſsful, who paſſed along the coaſt of *Nova-zembla*, as far as the ſeventy ſeventh degree of Northern-latitude: For it is well known to all that ſayl Northward, that moſt of thoſe Northern coaſts are frozen up many leagues; though in the open Sea it is not ſo; no nor under the Pole it ſelf, unleſs by accident, as when, for example, upon the approach of the Summer, the froſt breaketh, and the Ice, which was congealed near forty or fifty leagues to the ſhoar, breaks off from the land and floats up and down in the Sea.

This was the main obſtruction to thoſe that directed their courſe ſomewhat higher towards the North; who encountring with the vaſt flakes of Ice, which coming from the ſeveral ſhoars are driven to and fro in all parts, were forced to quit their deſign, and ſtand back for their own Country.

There was, ſome years ſince, a knot of Merchants of *Amſterdam*, who attempted thoſe Seas with much better ſucceſs than the former. For, being advanced to the ſeventy ninth or eightieth degree of Northern-latitude, they paſſed above an hundred leagues above *Nova-zembla* toward the Eaſt: And, although they gave

ſtrict

ſtrict charge to conceal what they had ſeen and obſerved; yet it became publickly known, that they had diſcover'd a Sea, beyond *Nova-zembla*, free from all Ice, and very convenient for Navigation.

Theſe being return'd to their own Country, with great hopes of finding encouragement to make further diſcoveries, petitioned the Lords the States General of the United Provinces, That, ſince they had granted the Trade of almoſt all the World to the Governours of the Eaſt and Weſt-*Indian* Companies, and that there remained ſcarce any thing to the reſt of the Merchants (who, in their opinion, had deſerved as well of the Common-wealth as themſelves) beſides the Trade of the *Mediterranean* and *Baltick*-Seas, they would be pleaſed to grant the Navigation of the Northern-Seas, and of the *Eaſtern* (not yet diſcovered) to them, excluſive to the Eaſt and Weſt-*Indian* Companies; and that ſo much the rather, becauſe that, many years ſince, the *States* had, with the promiſe of great rewards, invited men to the diſcovery of the Northern paſſage to *China* and *Japon*.

But the Governours of the Eaſt-*Indian* Company being ſenſible, how nearly this concerned them, preſented likewiſe their Croſs-petition, deſiring, that the petition of the ſaid Merchants might for the future be referred to them and their conſideration: And as for the reward, which the *States* had promiſed, they would take the performance of it upon themſelves, and proportion it as they ſhould ſee juſt cauſe.

The Merchants, finding their Petitions thus croſſed, addreſſed themſelves to the King of *Denmark*, who immediately granted their demands. Under his protection therefore they equipped two or three Ships, ſuch as they judged moſt proper for this voyage. Which when the Governours of the *Dutch* Eaſt-*Indian* Company had information of, they raiſed a conſiderable ſum of mony, and eaſily perſwaded the Mariners to deſiſt from ſo dangerous (for ſo they repreſented it) a voyage; and yet, that the Merchants might have no juſt cauſe to complain againſt the ſaid Company, the Mariners went to Sea; but neglecting the directions and orders of thoſe Merchants, they ſteered their courſe directly for *Spitzberg*, took in their lading of Fiſh, and returned home.

Upon which the East-*Indian* Company of the United *Netherlands* omitted neither ſtudy, nor care, to find out a paſſage through the North-Eaſtern Sea for thoſe who were to return into *Europe* from the East-*Indies*.

There was then much diſcourſe of the Gulf of *Anian*, by which a paſſage was ſaid to be open into the *Tartarian* Sea: And ſomething they underſtood from the people of *Japon* and the *Portugueſes*, of the Country of *Jezzo* which lay above *Japon*. But not reſting ſatisfied with the bare relation, in the years 52 and 53 † ſent out ſome dextrous perſons to diſcover thoſe coaſts; who paſſing beyond *Japon*, the fiftieth degree of Northern-latitude, arrived upon the coaſt of *Jezzo*, where they fell into a narrow Sea, yet broad and convenient enough to lead into the Northern Ocean. The oppoſite ſhoars they called **Het Compagnie land** *, and an Iſland ſeated in the middle of the Gulf they called **Het Staten Eyland**. Many things are written concerning the ſtate and condition of theſe Countries, and many more may be found in the Journals of the Maſters of Ships and Pilots, which are induſtriouſly concealed.

† *Compare* Numb. 109. *of theſe Tracts*, p. 261.

* *Which is indeed the Weſt-Corner of the Northern* America.

Whether this Land of *Jezzo* be annexed to *Japon* or not, the Inhabitants of both Countries doubt, becauſe vaſt and unacceſſible Mountains interpoſe, which hinder the communication. Neither doth it as yet clearly appear, whether this Land of *Jezzo* be a part of *Tartary*, or whether by an arm of the Sea divided from it. The *Chineſes* affirm, that *Tartary* runs three hundred *China* Leagues Eaſtward beyond their famous Wall: So that, if we follow theſe, the Country of *Jezzo* and *Japon* may ſeem to be annexed to *Tartary*; but thoſe of *Jezzo* ſay, that there runs an arm of Sea betwixt them and *Tartary*: Which opinion may ſeem to receive ſome confirmation from what thoſe *Hollanders* affirm, who ſhipwracked ſome years ſince upon *Corea*, a peninſule of *China*. They ſay, that they ſaw there a Whale, upon whoſe back ſtuck a Harping-Iron of *Gaſcony*. And the credit of this aſſertion not being queſtioned by any, it is moſt probably to be conjectured, that this Whale paſſed from *Spitzberg* through

the neareſt arm of the Sea, rather than through the more remote. Be it how it will, we may hence ſafely conclude, that the Sea which lies betwixt *Japon* and *Spitzberg* is paſſable, and that through more perhaps than one arm or channel, by which they communicate.

But to go on: After the Experiments made by the Governours of the Eaſt-*India* Company, in the years 52 and 53, they reſolved to proceed no further upon the Diſcovery; as well becauſe the Emperour of *Japon* interdicted the Navigation of Forraigners into *Jezzo*, in regard (as they ſay) of the vaſt tribute which he raiſeth annually upon the Silver-Mines there; as becauſe they think, it may little conduce to their † advantage, to have this compendious way of Navigation diſcovered. And therefore they have thought fit to prohibit all farther ſearch into the Navigation to *Jezzo*, and the Countries adjacent; upon which very reaſon they have alſo endeavoured to conceal their *Auſtral* Plantations.

† *It may be more to the advantage of* England.

Now concerning that tract or ſpace which lieth betwixt *Spitzberg*, *Nova-zembla*, and the Straights of *Jezzo*, we have no reaſon, for ought I ſee, to entertain any doubt; though not ſo much in regard of the paſſage, which the Whale abovementioned found, (that being but a conjectural ground,) as becauſe many of the *Muſcovite* * Itineraries aſſure us, that the Coaſt of *Tartary* runs not North-ward from *Nova-zembla*, but turns up very much towards the Eaſt; ſo that the Head-land of *Nova-zembla* is far the moſt Northern part of all *Tartary*.

* *It were not amiſs, for the better finding the North-East paſſage, to ſtay ſome years with the* Ruſſians *or* Muſcovites *in* Samojetia, *and to make a familiar acquaintance with that people, who ſeem to know that paſſage. Many things might be diſcovered in this manner, both as to Iſlands and* Terra firma.

This may likewiſe be collected out of the Hiſtories and Mapps of *China*, which affirm, that thoſe who paſs from the Wall of *China* Northward, may, in the ſpace of fourteen days, reach the Sea. And the coaſt of *Tartary*, which lies beyond the

Samojeds

Samojeds, sufficiently testifieth the neighbourhood of the Sea, forasmuch as the farther any man advanceth towards the East, the milder and better cultivated all things appear to him: For the *Muscovites* have there observed large and navigable Rivers, and fair Cities abounding with plenty of all manner of things.

It remains now, that we should enquire, by what Course, and in what Season of the year this Voyage is chiefly to be undertaken? It is hardly to be doubted, but that the Straight which lies betwixt *Spitzberg* and *Nova-zembla* may be passed; and the course is to be directed to seventy eighth, seventy ninth, and even to the eightieth degree of Northern latitude. If any man shall, holding the same course, proceed farther, he will find the passage shorter; for, if we draw a line to pass from our Seas through the seventy eighth or seventy ninth degree of Latitude to the Straight of *Jezzo*, it will be very near a streight line: But if any would from the same degree of Latitude (having passed *Nova-zembla*) chuse to decline toward the coast of *Tartary*, and coast along by it, till he meet with some Straight, he would find his Course somewhat longer, but peradventure safer and better; since many Straights would seasonably present themselves to him; and he might safely neglect the measure of Longitude, which in open Seas (and especially those that are near the Pole) is found difficult to be observed. Neither ought this to be any hindrance, but that the other way may be frequeuted; for, though in places near the Pole, the moments of Longitude have great variety in a little space, yet there ariseth not any great difficulty from thence; since the fault may easily be prevented in lesser Circles: For grant, that any Mariner in the observation of his Longitude should mistake a whole quarter of the Compass (which may easily fall out in one daies sayling,) there could no great inconvenience follow; since the mistake, in regard of the shorter spaces of Longitude, may be rectified in a lesser interval: Nor is there any man that knows not, that the Parallel circles, the nearer they are to the Pole, the more they are contracted, till they all end in one point; so that the Errour cannot be very great, wich falls out in Longitudes so contracted.

As

As to the Time of the year, wherein this Navigation ought to begin, it may be conſidered two ways: In the beginning of the Spring, *viz.* in the month of *March*, it is confeſſed by moſt men, that the Winds and Seas are favourable to thoſe that ſayl to *Spitzberg*, and the places near the Pole, and that they may run all that courſe from theſe parts in twelve or thirteen daies ſpace: But when they have paſſed ſo far, if any man would deſign to ſayl to the Straights of *Jezzo*, he muſt ſteer his Courſe towards the South: But then thoſe motions of the Winds and Seas, which were favourable to thoſe who ſayled Northward, will be contrary to thoſe who ſtand Southward, and they may long enough expect Northern gales, which ſeldom blow till towards the latter end of Summer, *viz.* in the month of *Auguſt*. If therefore any man would contrive to diſpatch his voyage in the ſhorteſt time, it were his ſafeſt rule to make choice of that time of year, wherein he might ſooneſt make to *Spitzberg* to and again, which I conceive would be in the beginning of Summer; yet it would be ſafer to ſet out ſooner, if the Wind permit. And although this Courſe ſhould happily ſucceed, it follows not, that I ſhould adviſe them to obſerve the ſame in their return homeward; for, things of that nature muſt be left to the prudence and conduct of diſcreet Pilots and Mariners; who are yet to be advertiſed, that, ſince the greateſt part of this Navigation is to be ſought through unknown Seas, they ſhun, as much as in them lieth, all near approach to the Coaſts and Iſlands which they ſhall encounter, for fear of the Ice; and that they always make choice of the moſt open Seas, which are leaſt infeſted with it, and in which the Colds are moſt moderate. For, experience hath ſufficiently taught, that whole large Seas are never known to be frozen, but the borders of the Seas near land only, and theſe by reaſon of the plenty of *freſh* waters that run into the Ocean, or the Snows melted in it. And the ſame experience hath taught, that there is not that danger from the fluctuating Ice as is vulgarly apprehended, eſpecially in Seas not ſubject to violent ſtorms, and within the ſixth or rather the eight month of the year.

But

But in case that frequent Lands and Islands are to be passed, it will be the safer course to chuse the largest and most open Channels, and not to sayl near the sides that lie to the North, but to chuse rather the Southern shoars, which are seldom, or at least not so much, pester'd with Ice.

When the nature of this Sea and of its several Straights shall be more perfectly discover'd, it is not to be doubted, but that the whole Voyage betwixt Us and *Japon* may be performed in the space of five or six weeks, at the most. But in case it should, either by accident or gross errour, so fall out, that the Ships should be forced to winter there before they could recover home, this likewise might be done without much danger; provided that they avoided the unadvised proceeding of the *Dutch*, who being caught, and necessitated to pass the winter in the most Northern Climats, planted themselves there upon the highest lands, in Hutts fram'd of thin boards, (whereas in *Lapland* it self it is impossible to live so;) but they ought to sink their houses under ground, and to heap much earth over them; since 'tis not possible, or, at least, extreamly difficult for men to subsist in such an excessive severity of Winter, unless they nest themselves deep under the Earth.

An

An Extract of a Letter to the Publisher from a *Spaniſh* Profeſſour of the Mathematicks, propoſing a New place for the firſt Meridian, and pretending to evince the Equality of all Natural daies, as alſo to ſhew a way of knowing the True place of the Moon.

Cùm totus Orbis, Clariſſime Vir, Sereniſſimi Magnæ Britanniæ *Regis laudatiſſimum inſtitutum Regiæ Societatis maximi faciat, poteſt illud antiquum revocare*, Regnum iſtud fœlix, ubi Rex philoſophatur. *Jam indies utilitates ab hoc dimanantes abundè dignoſcuntur, & literati ex omnibus terræ locis, tanti* Mecænatis *auſpiciis, certatim Novi & Certi aliquid conantur in lucem afferre. Etſi ego ingenii mei tenuitatis non ſim ignarus, tamen non reticebo meum à teneris ad ſcientias deſiderium & conatum, quo impellente per annos undecim præcipuas Europæ Regiones & Regna ſum pervagatus: Inter ea, mihi in* Anglia *fuit per annum commoratio; quare Anglicam Humanitatem expertus, non dubito, quin, etſi ignotus, & prope Herculis columnas degens (ubi antiquitùs terræ finis putabatur) gratiam & benevolentiam à te, clariſſimo Viro, ſim impetraturus. Eſt inter homines Societas illa humana quæ nos conjungit, & in nobis ſtudiorum conſenſus, amoris Vinculum coarctans; ideo non eſt quod diffidam, Te mea Vota aliter accepturum, quàm ſoles Exterorum aliorum ſcriptis benignè reſpondere.*

Etſi omnes Mathematicarum partes ex animo colam, tamen Geometria *&* Aſtronomia *mihi in pretio maximè ſunt; & cùm primò occurreret, quis in Globo Terraqueo locus, Longitudinis principio eſſet aptior, nullam inveni inter auctores, quos legebam, concordiam; aliis* Heſperides Inſulæ *pro primario Meridiano placebant; quibuſdam* Corvi Inſula; *pluribus* Fortunatæ inſulæ; *non-nullis* Palma Inſula; *aliis alia atque alia loca, de quibus ingenioſus* Stevinus *multa diſſerit; quanquam in omnibus locis his, & pluribus aliis,*

 longitudo

Longitudo terreſtris poſſit infigi atque conſtitui, attamen videbatur mihi, aptiorem locum quærendum, qui omnibus prædictis eſſet anteponendus, & concordiam ferret inter Geographos ———.

Eſt verò terreſtris Longitudo, *Arcus æquinoctialis ab uno ad alium Meridianum interceptus, ſive temporis ſpatium, quod per æquinoctialem numeratur, inter duo loca; quare conſonum fuerit, longitudinis principium in ipſo æquinoctiali conſtituere.* ——— *Inſuper, cùm circulus iſte æquinoctialis Globum in Borealem & Auſtralem partem dividat, ſi detur hujus primarii Meridiani fixatio, in eo erit inter Boreales & Auſtrales æquitas atque conformitas,* ——— *Deinceps, oportet, ad præciſionem, locum hujus primarii Meridiani eſſe parvum, ut Longitudinis numeratio exactius exprimatur: Non, ut aliqui, qui omnes* Inſulas fortunatas *pro hujus principio aſſumebant, & diſtantiam duorum graduum, inter earum aliquas non notabant; quod certè abſurdum nimis erat.* ——— *Iterum, præcautio alia eſt habenda, ut primarius Meridianus non confundatur cum terris et locorum imaginibus in Globo vel Mappa exaratis, quod fiet, ſi per medias Terras tranſeat; ideo ſtatuendus in loco hujus confuſionis experte; & ſi præcipuas Terræ partes dividat, ut* Americam, Africam & Europam, *per Maria tranſiens, erit eò aptior & convenientior in Globi terraquei repreſentatione; quas omnes memoratas cauſas conſiderans, poſtea inveni, quòd Natura (nihil fruſtra ſuppeditans) poſuit ſub ipſo Æquinoctiali circulo Inſululam quandam prope* Braſiliam, *olim* Abromos *nominatam, quæ Inſula diſtat à* Teriſæ Pico *Gradus* 9. *Occidentaliores, & ab* Uraniburgo *gradus* 42. *Occidentaliores; in qua inveniuntur omnia ad Primarium Meridianum conducenda, ut à me æſtimatur: Hac de cauſa pergratum mihi erit, ſi Claritas tua hanc meam opinionem & inventum in* Societatis Regiæ *Congreſſu proponat, ut, ſi probetur ab ipſis, Univerſalis ſit poſthac inter Geographos Conſenſus, & mihi gratuler aliquid Eximiæ* Regiæ Societati *grati attuliſſe.*

Tranſeo ad alia: Non parvum adhuc eſt diſſidium inter Aſtronomos, quanta ſit in æquando tempore Proſthaphæreſis, ita ut Longomontanus *fateatur, nullam in Aſtronomico pulvere majorem difficultatem ſe inveniſſe; quod cùm notarem, animadverti in quibuſdam Cœli obſervationibus à me factis, quid ex illis eveniret;*

&,

&, cùm mihi esset Horologium rotatile pendulum, admodùm exactum, Lineâ Meridianâ artificialiter constitutâ, examinabam Solis in Meridianum ingressum, singulis diebus; cum quo ad amussim Horologium meum congruebat, & si discrepabat aliquando, rarissimè duobus minutis discriminabat, quod, cum opus erat, emendabam. Quare per triennium continuando & quotidie Solem in Meridiano observando, cum licebat (quod in hac Regionis parte sæpe sæpiùs fit) inveni tandem nullam Diem Naturalem longiorem revolutionem, in uno vel alio anni tempore, aliâ die habuisse: Unde intrepidè dico, omnes Dies Naturales æquales esse, &, si adhuc aliqua differentiola intercedit, non esse sensibilem. Hæc volui notum facere, ut Astronomos hoc scrupulo liberarem, quòd tam multos torsit & indies torquet, quamquam Tychonica *æquatio propter Eclipticæ obliquitatem non sit rejicienda.*

In Lunæ motibus non parùm his præterlapsis annis desudavi, &, quia instrumentis magnis carebam ad perficiendas observationes, ferè animum demisissem; sed, Mercurio instigante, & difficultate rei magis incensus, tandem inveni modum Lunæ locum sciendi, exili quodam instrumentiolo tantùm adjutus; nam cætera Triangulorum ratiociniis perago; &, quod mirum est, nec Refractiones nec Parallaxes meis observationibus obsunt, quia ingeniosa Methodus his tricis me liberat. Perfeci plures quàm Centum observationes Lunares & aliorum Planetarum, primò non adeò exactas ut desiderabam, sed postremò ad unum vel duo Scrupula eorum loca capiebam, & sic continuando per plures observationes congruentes, inveni, distantiam Civitatis Hispalensis *longitudinariam, esse ab* Uraniburgo *Nonaginta minuta, sive Horam cum dimidia, vel intra duo minuta differentem:*
Possum hac Methodo Terrâ Marique uti; Ideo ta- NB.
bulis Lunæ correctis non amplius Modus, desideratas locorum Longitudines captandi, in omnibus Terræ Marisque locis, ignorabitur (Astris conspectis;) quod, cùm oportebit, experientiâ comprobabo. Nondum differentiam alicujus magni momenti inter Lunæ locum, mea Methodo observatum, & numeris Tychonicis inventum, percepi, &, hìc infrà, Eclipsim Lunarem tradam, à me in hac Civitate observatam, quæ omnibus numeris congruit

Tychonicis *Tabulis, sed in quibusdam aliquantulum à me emendatis. Observatio fuit admodùm exacta; nam Sole prope Horizontem existente, per hujus loci Altitudinem Minutorum tempora facilè innotuerunt: Cætera meo Horologio (quod ne unum quidem minutum ea die discrepabat) notavi, ita ut nulli dubio in observatione detur locus. Hujus ratio sic est,*

Observatio Lunaris Eclipsis *Hispali* peracta, die 21 *Januarii* styli Novi Anni 1675.

	hor.	′	
Initium veræ Umbræ	4	56	P. M.
Immersio	6	1	
Emersio	7	33	
Finis	8	39	& aliquantulum productior.

Jam Tempus est, ut te dimittam, Vir Clarissime, & quamquam plura remaneant impertienda, in aliud tempus differam, ut interea etiam scire possim, an tibi hæ meæ lucubrationes placuerint, & reciprocum in te amorem invenerim, quod ex animo opto. Vale quam diutissimè. Datæ Hispali 20 *die* Augusti *styli Novi Anno* 1675.

A Return to the former Letter.

Quòd veteris hoſpitii, exhibitæque olim in Britannia *noſtra humanitatis memor, Vir ſpectatiſſime, Philoſophicum ejuſmodi, quale Epiſtola tua continet, redhoſtimentum nobis tranſmittere voluiſti, in eo equidem generoſam virtutis tuæ indolem abundè conteſtaris. Gratulamur nobis quam maximè, quòd & in* Herculis *Columnarum vicinia viri illuſtres degunt, qui in Scientiarum decus & augmentum ſuas noſtris conſociare operas cordatè ſatagunt; quos inter cùm Tu, Vir Egregie, eminere nobis videaris, ob inſigniorem Geometriæ & Aſtronomiæ cultum, magno ſanè affectu Te & ſtudia tua amplexamur, Tibique commercium noſtrum Philoſophicum, inter cæteros reip. literariæ cives, ſumma cum lubentia oblatum volumus. Cæterùm, cùm* Regia *noſtra* Societas *cætus ſuos publicos æſtivis menſibus ſueverit intermittere, nec eos hac æſtate in hunc uſque diem inſtauraverit; Ego autem debitam Tibi reſponſionem diu nimis protelare noluerim; En tibi Regii noſtri Aſtronomi, Doctiſſimi* Flamſtedii, *Epiſtolam, quam perlectis & penſitatis literis tuis ad me dedit, in hæc verba hîc ſubjunctam;*

Amico plurimùm colendo

Dom. *Henr. Oldenburgio* Regiæ Societati à Secretis,

Joh. Flamſtedius S. P.

CUm me rogaveris, Vir Clariſſime, ut meam, pro munere quo fungor Aſtronomico, de iis, quæ in nuperis ad Te datis literis aſſeruit Profeſſor *Hiſpalenſis*, opinionem referrem, rem quâ poſſum brevitate expediam. Miſſis autem hac vice iis, quæ de *Primi Meridiani* loco ingenuè admodum diſſerit, ea duntaxat, quæ de Æquatione dierum, deque Inſtrumentiolo, quo-

quo-cum ſuas peragit Obſervationes, pronunciavit, nonnihil excutiam.

Dies igitur, ut hinc ordiar, quomodò æquales eſſe poſſint, & tamen Æquatio *Tychonica* admitti, vix me capere fateor. Ob inæquales etenim æqualium Eclipticæ partium Rectas Aſcenſiones dies unus Æquinoctialis Tropico uno brevior erit ſcrupulis horæ ſecundis 40″; & dies 14 Tropici, totidem Æquinoctialibus longiores ſunt ſextâ horæ parte ſeu ſcrupulis primis 10′. Hanc autem differentiam majorem credo, quam ut eam in obſervationibus ſuis non perciperet Profeſſor *Hiſpalenſis*, proindeque ipſum in examinandis iis *Tychonicam* temporis Æquationem adhibuiſſe autumem; quod num reverâ fecerit nec ne, reſcribat oro.

Sed & ponamus, Æquales eſſe Primi Mobilis revolutiones (quod nulli, qui *Ptolemaicam* Hypotheſin admittunt, unquam iverunt inficias) neceſſariò conſequitur, nec Æquationem Temporis, ab Inæquali Solis in orbita ſua inceſſu enatam, rejiciendam eſſe: Etenim cùm *Apogéus* quotidie promoveatur tantùm 57′. 10″, *Perigeùs* verò 61′. 15″; Apogeus equidem citiùs 16″, ſeu tempore abſumpto dum Primum Mobile revolvit 4′. 5″, à meridie in Meridianum diei ſequentis recurret, quàm Perigeus: Attamen, quandoquidem progenita ex hac cauſa Æquatio tardiùs admittit diurnum incrementum, ſcilicet 8″ quotidie; ad ſummum cùm velociſſima, & vix diebus 15 ad duorum ſcrupulorum quantitatem excreſcit, eâ, cujus ille meminit, duorum ſcrupulorum emendatione in horologio ſuo ablatam credo: de qua videat propterea Vir doctiſſimus; atque, ſi obſervationes repetat, de peralto ſibi gnomone, nec non de linea Meridiana, accuratè in firmiſſimo lævigatoque pavimento deſignata, proſpiciat, curamque adhibeat, ut eandem ſemper Horologii Perpendiculum longitudinem ſervet, cùm ſecus in incertum omninò reditura res ſit. Hiſce verò probè obſervatis curatiſque, nullus dubito, quin temporis Æquationem ſit percepturus; qua de re ſi certiores nos faciat, rem omninò gratam nobis præſtabit, qui pares hîc obſervationes meditamur.

Demum

Demum verò, si in *Copernicanam* hypothesin sit pronior; quàm in *Ptolemaicam*, in ea etiam, suppositis Terræ isochronis revolutionibus, eædem consequuntur Æquationes; de quibus in Diatriba mea, posthumis *Horroxii* nostri operibus insertâ, (siquidem ea in *Hispaniam* pertigerit,) fusius ediffertatum comperiet. Fateor equidem, amoveri posse & in contrarium trahi, ab inæquali incessu Solis in orbita sua provenientem temporis Æquationem, si inæquales Terræ vel Primi Mobilis (perinde enim est utrum horum statuerimus,) Revolutiones supponamus: Sed si Temporis naturam bene perpendat, facilè intelliget, impossibile esse, omnem ejus inæqualitatem removeri.

Quod de Instrumentiolo suo scribit, fidem meam (quod bonâ ipsius veniâ dictum velim) superat. Privari enim Luna nec Refractione nec Parallaxi in horizonte nostro potest, nisi ad *Zenith* aliquando posset pertingere; eoúsque enim extenduntur, ejusque locum implicant Refractiones: Desinit in nonagesimo gradu Ecliptica semel tantùm de die Longitudinis Parallaxis, sed Latitudinis non perinde. Nec satis capio, quomodo fabricari instrumentum possit, quod unà cum Parallaxi Refractionem, cujus incrementum longè diversam habet rationem, consideret. Videat etiam Epistolæ illius Author, quomodo Meridiani *Hispalensis* ab *Uraniburgico* interstitium scrupulorum 90′ constituerit: Deliquii enim Lunaris Observationes *Januar.* $\frac{1}{11}$ 1675, *Londini* medium ponunt h. 7. 11′$\frac{1}{2}$ *p. m*; cui annotationes *Parisinæ* consentiunt; dicti Professoris Observationes medium *Hispali* statuunt h. 6. 47′: Nostrorum ergò Meridianorum differentia 24′$\frac{1}{2}$: At *Nos* inter & *Uraniburgum* non intercedunt nisi minuta 52″. Est igitur Meridianorum differentia nonnisi 1 h. 16′$\frac{1}{2}$ inter *Hispalim* & *Uraniburgum*. Vereor tamen, annon oculis nudis Domini Professoris factæ fuerint Observationes: Incidentiæ quippe & Emersionis tempora faciunt 1 h. 5′; cùm *Nostræ*, *Parisinæ*, *Hevelianæque* Observationes non faciant ea tempora plus quàm 1 h. 1′$\frac{1}{2}$, forsan aliquantulò minus. Rogo igitur, Telescopia imposterum Observetionibus suis adhibeat, nobisque significet, quomodo ipsius cum nostris *novissimæ* Eclipseos Observationes

ſervationes congruant, quam hîc *Londini* in ædibus *Jonæ Mori* Equitis obſervavimus, ſcil. *Junii* 27. 1675. ſt. vet.

	h.	′
Initium, manè hora	1.	46.
Immerſionem, hora	2.	57. ferè.

Præterea Dom. Profeſſorem roges, oro, ut obſervatam Poli *Hiſpalenſis*, ut & *Conimbriæ*, ſi conſecutus eſt, Altitudinem nos edoceat. Valeas, & Ampliſſimo Viro, nomine meo, ſalutem plurimam dicas. Dab. *Grenovici* Sept. 14. ſt. vet. 1675.

Hæc ſunt, quæ Flamſtedio *noſtro, viro certè in Aſtronomicis verſatiſſimo, inque Obſervationibus peragendis accuratiſſimo, viſum fuit ad epiſtolam tuam annotare, quæ ut boni conſulas, deque iis ſententiam tuam proximè aperias, oro.*

Vale, Vir Spectabilis, & rem Aſtronomicam diligenter augere perge. Dab. Londini *d.* 15. *Sept.* 1675.

An

An Accouut of two Books.

I. Jacobi Barneri, *Ph & Med. D. Augustani*, *PRODROMUS SENNERTI NOVI, seu Delineatio Novi Medicinæ Systematis, &c.* Augustæ Vindelicorum. *A.* 1774. *in* 4*o*.

AS the famous *Sennertus* made it his busines to represent in his System of Physick, whatever was known and practised by the Antient Masters of that Art, until his days; so this Author is very desirous, that a System, after the manner of that of *Sennertus*, might be composed, wherein not only from the new Anatomico-Chymical Discoveries, that are made since the time of that great Physitian, the doctrine and practise of the Antient Doctors, delivered in *Sennertus*, might be examin'd, but also the Doctrines and Practises of the Modern Physitians themselves discussed and considered, that so it might appear, by what truth they are all supported, and how consistent with one another they are; and Students of Physick the better directed what to learn and follow in the same.

In order to which great Work, our Author declares, that he who shall duly perform such a task, must be both accomplished in sound Philosophy, and furnished with all kind of Anotomical, Chymical and Practical Knowledg: And therefore not daring to undertake such a Work, which requires the study, industry, observations and experience of more than one age, he thought fit only to publish a *Prodromus* or Introduction to it, wherein he gives notice;

First, that he shall premise to this Work what belongs to the Grounds of the whole Art of Physick, and withal discourse of the Origine and Progress of the same.

Secondly, that that being done, he ſhall proceed to the Work it ſelf, wherein he profeſſes his reſolution of receding from the common Methods of Syſtems, (not excepting *Sennertus* himſelf) in which he judges there hath been delivered a great multitude both of uſeleſs ſpeculations and tedious repetitions, rendring the Art very prolix and difficult, to the great retardment and confuſion of the Students thereof; whereas, in his Judgment, it may, by the advantage of a good method, be ſo deliver'd, that in a very ſhort time the Grounds of the whole Art may be acquired: Alledging, to the honor of the famous Dr. *Sylvius*, that he taught his Auditors the whole Method of Curing Diſeaſes in *Seven* Lectures; and citing alſo that antient Author *Theſſalus Trallianus* for affirming, that the ſame Art might be taught and learned in the ſpace of *ſix* Months: Whereupon he ſcruples not to engage his honor, that by *his* Method, (of which he gives the Scheme in this Book) he will teach a man, that is competently inſtructed in Anatome and Chymiſtry, the whole Art of Phyſick not in ſix *Months*, but in ſo many *Weeks*.

To remedy therefore the complained of prolixity and difficulty, he pretends to compoſe a Syſtem of Phyſick, wherein whatever is ſuperfluous ſhall be laid aſide, and particulars reduced to general Heads, and all matters comprehended, which from the firſt riſe of this Art have been publiſhed to this very time. In the doing of which he propoſeth to himſelf the following Method.

1. He will deliver, chiefly out of *Sennertus*, the Doctrine of the Antients concerning all ſorts of Diſtempers, and examine the ſame.

2. He will conſider, what *Hofmannus* hath written againſt the *Inſtitutioniſts* (as he calls them) and *Sennertus* himſelf.

3. He will examine *Paracelſus* and his followers, eſpecially *Severinus*.

4. He will weigh what hath been written by ſome to conciliate the *Paracelſian* Doctrine with that of the Antients.

5. He

5. He will propoſe the Doctrine of *Van Helmont*, and declare, wherein he agrees with, and diſagrees from him.

6. He will diſcuſs the dogma's of all the Moderns, that are hitherto come abroad, and particularly thoſe of *Willis*, *Sylvius*, *Barbette*, and ſuch others as are deduced from the *Harvean*, *Gaſſendian*, or *Carteſian* principles.

7. He will ſeriouſly conſider, How far the doctrine of the Ancient and Moderns may be reconciled, to the end that we may at laſt come to ſome certainty.

8. Laſtly, he will deliver his own Judgment of the cauſe of every known Diſeaſe, conform to Anatomico-Chymical principles; declaring, that he ſhall, where he ſees cauſe, repeat the Cauſes aſſigned by his Predeceſſours, but, where not, deliver new ones.

All which Heads, he ſaith, he hath ready in a Scheme, of which he only gives here a delineation, and that in *ſix* parts:

The *firſt* is the *Pathologia*, of Diſeaſes and their Cauſes; which he means to diſpatch in *three* Sections: whereof

1. Shall treat of Diſeaſes, their Differences and Cauſes in general; and then of *Hippocrates* his Θεῖον; of the *Archeus*, Ferments and Idea's; of the *Humors* according to the Moderns; of the three Principles of the *Paracelſians*; of the *Hippocratical* Acid, Sharp, Bitter, Salt; of the Occaſional and Accidental cauſes of Diſeaſes, the Natural and Non-natural things, and the Celeſtial Influences, &c.

2 and 3. Of Diſeaſes both general and particular, and their Claſſes, according to his own Method, which is grounded upon that of *Hippocrates* his diſtinction of parts into *contentas*, *continentes* and *impetum facientes*; according to which he will treat of all Diſeaſes, as they reſpect the Spirits, the Juyces and Excrements, and the three Venters.

The *Second* is the *Semiotica*, which ſhall deliver the ſigns both *Diagnoſtick* and *Prognoſtick* from their very Cauſes both

according to the Ancients and Moderns, but especially from the tr er Principles by him pretended and assumed. And here he will *first* discourse of the Signs, their fountains, differences and causes in general, the Pulse, Urine, &c. as also the signs of Life and Death, the Crisis and Critical daies, and the like. *Then*, of the particular and proper Signs of every Disease.

The *third* is the *Pharmaceutice*; wherein he will treat *first* of the *Materia medica*, as it is taken from Meteors, for example, Dew, Manna, Snow, &c.; or from Minerals, Vegetables, or Animals; where he intends to consider, Whether all those Medicines, that are commonly vendible in Shops, are necessary, or sufficient; as also, How, When, and Where divers things, belonging to the *Materia medica*, are to be gathered; and likewise of the marks of their goodness, the ways of preserving them, the skill of knowing and discerning the vertue and force of Medicines, and the degrees thereof. *Secondly*, of the *Galenical* Preparations of Medicaments, both liquid, dry, and of a middle consistence. *Thirdly*, of *Chymical* Preparations, concerning which he promiseth to communicate the very method by which he hath performed them, which he calls his *Chymia Philosophica*, that shall endeavour to give the causes of all those Chymical operations from the genuine principles of Art; declaring, that he will deliver not only the vulgar, but also uncommon processes, and engaging his faith, that he will write what he knows to be confirm'd by Experience it self; further promising his strictures and examinations of false and erroneous processes, together with a way of examining all sorts of preparations and processes, in reference to Medicines; and referring an intire System of Chymistry and the use thereof to his *Prodromus* of *Natural Philosophy*. *Fourthly*, he will treat of the Method of prescribing forms both of *Galenical* and *Chymical* Medicines, and mark the Errors so frequently committed in their composition. *Fifthly*, he will annex to this part his thoughts of common *Dispensatories*, and substitute a new one of his own, laying by, what, in his opinion, is useless, and taking in what of late hath been discover'd and tried to be useful; applying also the uses of the Medicaments of this his new Dispensatory to the respective Diseases treated of in the rest of his great work.

The

The *fourth* is the *Hygieine*, for the Conſervation of Health; in which part he thinks there hath been hitherto a great neglect, in that no ſpecial regard hath been had to the particular functions of the *viſcera*; which hath induced him to order this part of Phyſick according to the *ſeries* of the ſeveral digeſtions made in the Body, and not juſt according to the *claſſes* of the things called Non-natural. This part he divides into four Sections; of which the *firſt* is to contain ſome *prolegomena* upon this ſubject; the *ſecond* to treat of the regimen of Health in general; the *third* of the ſame in particular; the *fourth*, moſt eſpecially of ſuch Medicines, as are eſteemed to be endowed with a peculiar virtue, conducing to long life.

The *fifth* is the *Therapeutice*, for the Recovery of Health and the Curing of Diſeaſes: And that *firſt* in general; where will occur the *Empirical* way of the Ancients, as alſo the *Galenical*, *Paracelſian* and *Helmontian* Method; *item* the recent way of Injection into veins, and the Transfuſion of blood. *Secondly*, in particular; where he intends to diſcourſe of the poſſibility of an Univerſal Medicine; as alſo of the way of curing all ſorts of Diſeaſes by peculiar Methods and proper Medicines: Where he purpoſes to mention and recommend the ſucceſsful Cures of the famous Dr. *Michael*, late Phyſitian of *Leipſick*, and to impart his ſelect and happy Experiments, &c.

The *ſixth* part, ſhall treat of the Requiſites in a good Phyſitian in his daily practice: To which he will ſubjoyn a compleat enumeration of all Diſeaſes, which ſhall take notice of thoſe that have been omitted by common Authors; and laſt of all, by way of Epilogue to the whole work, the *Deſiderata* in Phyſick, together with a Method for abſolving the ſtudy of Phyſick, and a ſelect Library for that purpoſe.

II. *A Description of* HELIOSCOPES *and some other Instruments, made by* Robert Hook, *Fellow of the R. Society:* London, *printed for* John Martyn *at the Bell in St.* Pauls *Churchyard,* 1675. *in* 4°.

TOuching the Contents of this Book, as far as they relate to the Instruments therein described, I need say nothing here: I shall only touch upon some passages in the *Post-script* of it, in which I find one of these our Tracts concerned. The said Postscript then takes the liberty of reflecting upon a passage in *Numb.* 112*th.* of these *Transactions*, viz. about *the Invention of applying a Spring to the Ballance of a Watch*, finding fault with the same for not having taken notice, that *this Invention was first found out by an* English *man*, *and long since published to the World*, and complaining thereupon of *unhandsome proceedings.*

Now forasmuch as the former part of this accusation doth directly concern the Author of the *Transactions*, and the latter is so ambiguously worded, as that it may be referr'd to the said Author, as well as to the French *Journal des Scavans*, it was thought fit to acquaint the Impartial and Candid Reader with the plain *Truth* of this matter.

'Tis certain then, that the Describer of the *Helioscope*, some years ago, caused to be actually made some Watches of this kind, yet without publishing to the world a Description of it *in print*; but it is as certain, that none of those Watches succeeded, nor that any thing was done since to mend the Invention, and to render it useful, that we know of, until Monsieur *Hugens*, who is also a Member of the *Royal Society* as well as he is of the *Royal Academy* at *Paris*, sent hither a Letter dated *Januar.* 30. $16\frac{74}{75}$, acquainting us with an Invention of his of very exact Pocket-watches, the nature and contrivance of which

which he imparted to us (as he is wont to do other Inventions of his) in an *Anagram*; which he soon after, in a Letter of *Febr.* 20. $16\frac{74}{75}$ explained to us by a full description; for which the *R. Society* thought fit to return him thanks, yet so as to intimate to him, that Mr. *Hook* had some years ago invented a Watch of the like contrivance.

Not long after this there came over in the *Journal des Scavans* a *printed* Description of M. *Hugens*'s Invention, together with a Delineation of the Figure of the same, which the Author of the *Transactions* produced at the publick Meeting of the *R. Society*, where M. *Hook* not only saw it, but took a Copy of the Figure it self at the same time, unwilling to let him, that presented it there, take it home without permitting him first to copy it. Which done, M. *Hugens*'s Explication of his own way, together with the Figure thereof, was, at his desire, and after the perusal of the Noble President of the *R. Society*, printed the 12*th.* of *March* $16\frac{74}{75}$, in *Numb.* 112. of the *Transactions*; the Describer of the Helioscope well knowing, that it was designed to be published in one of those Tracts; who, if he had given to the Author of them the least intimation, importing that he desired, notice might be taken at the same time of his Invention of the like kind, it would have been certainly done, as hath been done upon other occasions, witness several of the same Tracts, wherein divers Discoveries of this Accuser have been formerly both printed, and vindicated from the Usurpation of others; though indeed it was not necessary it should there be done now, since the said Animadverser could speak for himself in print as soon as he pleased, as having laudably made use of late of the press for publishing himself his own Inventions.

This is the very truth of the matter, in which whether there be any thing on the part of the Publisher of the Transactions, that deserves that name of *unhandsome proceedings*, he very willingly leaves to all Ingenuous Readers to judge: Besides, it might justly be considered, that pregnant and inventive Heads, well versed in Mathematicks and Mechanicks, and furnish

furniſht with a genuine method of Inveſtigation, may, and not ſeldome do, fall upon the ſame Diſcoveries and Inventions about the ſame time, eſpecially if their minds have been long addicted to and engaged in the ſame Reſearches: Of which, if there be occaſion, ſeveral conſiderable Inſtances may be produced to verifie the Aſſertion. One of which, and fit to be taken notice at preſent, is, that when the Publiſher of the Tranſactions did, not long ſince, ſhew to the Accuſer that way of Monſieur *Leibnitz*, concerning exact portable Watches, which was printed in *Numb.* 113. of theſe Tracts, he did acknowledge, that though he had known that way too, ever ſince *A.* 1660, yet he never declared it to any body, and therefore could not ſay, M. *Leibnitz* had taken it from him.

Thus I ſhall diſmiſs him, not doubting, but that all Candid Readers will blame him for the expreſſion he uſes *p.* 30. of his ſaid Poſt-ſcript, which is, that he *forbears now to mention any further the carriage of the Writer of the Tranſactions in this affair:* And only adding, that if this Writer of Mechanicks ſhall think fit to explain what he means by it, he will certainly meet with a full anſwer, vindicating the Integrity of the Publiſher in ſuch a manner, that all *impartial* and *good* men ſhall be abundantly ſatisfied therewith.

——*Speque metuque procul.* Horat.

LONDON,

Printed for *John Martyn*, printer to the *Royal Society*, 1675.

PHILOSOPHICAL TRANSACTIONS.

November 22. 1675.

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Some Experiments made in the Air-pump *by Monsieur* Papin, *directed by Monsieur* Hugens, (*as appears in the Discourse printed at* Paris, 1674.)

TO mingle divers Liquors together by means of the *Air-pump*, there were employed two small Glasses, whereof the one could enter into the other, and the least of the two was fastned to the hook of an Iron-wire, and the greater put under it, and the said Wire was so ordered, that these two Glasses were a little distant one from another, until the Recipient † were eva-

† The *Recipient*, which was employ'd in this Engin, was of a Cylindrical figure, of which *one* end is all open, to be fastned to the cement of this Pump; the *other* is all closed, except a small hole, having a little edge or brim; through which hole you pass the hook'd Iron-wire, mentioned in the discourse, and tye an Eel-skin close about the same and three or four inches higher. The same skin is also to be tyed about the Iron-wire, to keep the external Air from entring into the Recipient, and yet without taking away the liberty to stir therein what you will by means of the Iron-wire, that hath a Communication inwards and outwards. For this purpose you must chuse that part of the Eel-skin that is next to the head, the other part being pierced with many holes with valves that do not always shut well.

To be the more sure, that no Air enters by the ligatures of the Eel-skin, you may apply a Tube on the Recipient with cement, and pour water into this Tube until the Eel-skin be quite cover'd therewith. Care also must be had, that the whole be exactly fill'd up by the Iron-wire; for, if it were too big, the Eel-skin would be thrust into it with great violence, and so hinder the liberty of raising and sinking it.

cuated of Air. Whereupon, by means of the Iron-wire, the leſſer Glaſs was let down into the greater, until the Liquors, they contain, did mingle themſelves. Thus ſome *Aqua fortis* was poured into the upper Glaſs, and *Spirit of Wine* into the lower, and the Recipient was ſo well exhauſted of the Air, that the *Spirit of Wine* boyled up with great bubbles (as uſually it doth,) and the *Aqua fortis* caſt ſome ſmall bubbles. After that both theſe Liquors were well purged of Air, the upper Glaſs was ſunk into the lower, ſo as that the Spirit of Wine was mingled with the *Aqua fortis*; at which inſtant there was yet ſeen a very conſiderable Ebullition.

Now to know, whether the *Aqua fortis* gave to the *Spirit of Wine* ſome new vigor or force to make it bubble; we mixed *without* the Recipient ſome *Aqua fortis* with Spirit of wine; the quantity of the former being ſomewhat more than that of the later. This mixture being put in *vacuo*, inſtead of boyling up more ſtrongly than the Spirit of Wine, (as 'twas thought it would have done,) it only caſt up ſome few bubles: Which ſhew'd, that the Ebullition, which was ſeen when they were mixed *within* the *vacuum*, is of the ſame nature with all thoſe that are made of Acids and Alcalies. For, in the very inſtant that they are mixed they make great ebullitions, but ſoon after they mortifie one another, and looſe the proprieties they had before. 'Tis alſo probable, that the *Aqua fortis* and the Spirit of Wine would boyl always, when they are ming'led, but that the preſſure of the Air keeps this ebullition from being ſenſible, and appears only when that preſſure is taken off.

When you employ rectified Spirit of Wine inſtead of *Aqua vitæ*, there is required a greater quantity of *Aqua fortis* to mortify it.

It was alſo experimented, that the ſolution of *Common Salt* boyls alſo with *Spirit of wine*, being mixed *in vacuo*, and the ſolution of *Salt-peter* yet more. The ſame Experiment was alſo made with common water, and it's ebullition with *Aqua vitæ*, purged of Air, was alſo found to be very great, when mixed *in vacuo*.

Further, it is ſomewhat remarkable, that *common Water* doth not mortify Spirit of Wine, as *Aqua fortis* doth, though they make ebullition with it almoſt of the ſame degree. The Experiment of it is eaſy: For, making *without* the Recipient, a mixture of *common Water* and *Aqua vitæ*, this, being put *within* the *vacuum*, bubles up very well, though the *common Water* be there in greater quantity than the *Aqua vitæ*; whereas a mixture of *Aqua fortis* and *Aqua vitæ* did not there buble up at all.

After

After this, the Experimenter being desirous to see, whether these Ebullitions did make new Air; he put in the Recipient a *Gage* (that is a *glass-tube* fill'd either with Water freed of air, or with Mercury, serving to measure the quantity of the Air in the Recipient) which was four Inches long, and observ'd, that at the instant when the Liquors were mingled together, the water in the Gage rose very nimbly to the top of the gage; and then drawing out this new Air that was made, he made the gage-water subside again by degrees, in like manner as when the common Air is drawn out: And by this means, it was seen, that all these kinds of ebulition make an Air which expands it self like common Air *.

* On this occasion, I am obliged to take notice, that (as 'tis recorded in the Journal-Book of the *R. Society*, A. 1668. *April* 30.) the honourable Mr. *Boyle* gave an account to the said *Society* of the Experiments, he had then made about generating new Air, or extricating that Air which was lurking before in several bodies: At which time he mention'd also some ways of examining, whether the substance thus produced be *true* Air or not.

And long before that time, *viz.* *A.* 1664. the 15*th.* of *March*, (witness the same *Journal*) Mr. *Boyle* mention'd to the *R. Society*, that Corals or Oyster shels pounded, and put into distilled Vinegar, might prove fit Substances to produce Air wholesom for Inspiration. At which time he also propos'd, that some fit *animal* might be put into a Receiver of his Exhausting Engin, and the Air pumped out till the creature grew sickish, and that then some new Air might be produced in the Receiver by a contrivance of making distill'd Vineger work upon the substances before-mention'd; to see, whether by this means the Animal would recover.

About which time Sir *Chr. Wren* also suggested, to put a fermenting liquor in a glass-ball, and to fit a stop-cock to it, and ty a bladder about the top of the stop-cock, by which means the Air, to be generated by the fermenting liquor, would pass into the bladder, and upon the turning of the stop-cock be kept there in the form of Air. Mr. *Hook* also mention'd several liquors, which by their working upon one another would produce an Air; as *Oyl of Tartar* and *Vitriol*; *Spirit of Wine* and *Turpentine*. And the same made before the *R. Soc.* the following Expeeiment: He took a common glass-viol with two Pipes, and some pounded Oister-shels and *Aqua fortis*; and as soon as the latter was by one of those pipes powred upon the former, and the hole stop't with good cement, the Ebullition, caused by the shels being corroded by the *Aqua fortis*, did in a very little time blow up the bladder, tyed on to the other pipe, so as to swell it very plump with Air; which expansion remained till the *Society* rose, after they had order'd the said vessel to be carefully lock't up till their next meeting, which being the week after, the bladder was then found somewhat shrunk. The like Experiment was made with *bottled Air*, supposed to yield a more wholsome Air for respiration, &c.

Yet here is something that seems to be very remarkable: which is, that the Air which is made by these ebullitions, is not of the same nature. For, it hath been found experimentally, that the Air formed by the mixture of *Aqua fortis* and *Copper* remains always Air, and always keeps up the water in the Glass at that height to which it raised it; but on the contrary, that Air which hath been produced by the mixture of *Oyl of Tartar* and *Oyl of Vitriol*, is al-

moſt all deſtroyed of it ſelf in the ſpace of twenty four hours, inſomuch that in the Recipient, twenty four hours *after* that the ebullition had been there made, there was not found much more Air than there was *before* the ſame was made.

One day we mingled equal parts of *Aqua fortis* and *Aqua vitæ*, and having put two equal quantities of this mixture in two ſmall Glaſſes with two equal bits of *Iron*, one into each; one of theſe Glaſſes was included *in vacuo*. Then there was ſeen a very great Ebullition, and the liquor became black, whilſt that was left *without* the Recipient wrought almoſt nothing, but remained alwaies tranſparent, and rather white than black. After theſe two Glaſſes had thus ſtood twelve hours, that which was in *vacuo* was taken out, and found, that the Iron was almoſt all diſſolved, whereas the other was very little diminiſhed. This Experiment ſucceeds quite contrary when 'tis made with *Aqua fortis* alone and *Copper*; for then the diſſolution is leſs *within* the *vacuum*, than *without* it.

We made ſome other mixtures of divers liquors, which make no ebullition at all in *vacuo*, no more than they do in the open Air. *Oyl of Olives* makes none neither with *Vinegar*, nor with *Spirit of Wine* at *the inſtant* that they are mingled; neither doth the ſaid Oyl mortifie the *Spirit of Wine*. Only this we obſerved one day, that having mingled together, *without* the Recipient, ſome of that *Oyl* and *Vinegar* and *Spirit of Wine*, and put this mixtnre in *vacuo*, it did not boyl up ſo ſoon as when there was no *Oyl*; but then the bubbles which it made afterwards were bigger, and they began to appear again from time to time, ſo that ſome of them were ſeen a quarter of an hour after the Recipient had been evacuated. Poſſibly this may come to paſs, becauſe that the Oyl, ſwimming on the top, retains the more volatil parts of the *Spirit of Wine*, which elſe would flie away as ſoon as the Air is begun to be pump'd out, and at the ſame time it hinders the ſurface of the liquor below from eaſily riſing up into bubbles, becauſe, to make them do ſo, the parts of the Oyl that ſtick cloſe to one another, muſt be ſeparated. When therefore the volatil parts are gather'd together in a ſufficient quantity, able to ſurmount the reſiſtance which the Oyl makes to it, they iſſue out with much more violence, than if nothing had retained them.

All theſe Ebullitions, hitherto ſpoken of, are greater in *vacuo* than in the open Air: But with *Lime* it is not ſo. For, taking two equal Glaſſes with two equal quantities of Water, and putting the

one

one of them in *vacuo*, the other in the free Air, there was let fall into both at the same time two equal parcels of *Lime*, one into each; and it appear'd, that that which was in *vacuo* did indeed throw up some big bubbles, but yet fewer of them than that which was in the Air: And having taken it, an hour after, out of the Recipient, and stirr'd the *Lime*, it was found to have only the consistence of Dirt, whereas the other had the consistence of flecked Lime. The reason of which may perhaps be, that the Volatil Salts of the *Lime* do exhale whilst the Recipient is emptying.

There was also some Plaister of *Paris* flecked in *vacuo*, and the Ebullition of it did there appear much more than it doth in the open Air. When it is not touched, the bubbles that issue out leave great holes in it, and then it settles very un-even; but taking care to stir it until the bubbles be come forth, and pressing it when it begins to settle, it becomes very smooth, and hath not so many little holes as the common Plaister.

A particular account, given by an anonymous French *Author in his book of the* Origin of Fountains, *printed* 1674 *at* Paris; *to shew, that the Rain and Snow-waters are sufficient to make Fountains and Rivers run perpetually.*

IN order to give a gross Estimat of the quantity of Rain *, compared with the quantity of Water running away in Springs and Rivers; it will be necessary first to agree of the way of measuring these two sorts of Water. Those that make profession of governing and conveying Spring-waters, say, that a cubick inch of water yields in twenty four hours 144 *muids*, (the name of a *French* measure, holding 280 *French* pints;) others say, it yields but 70 of that measure. For my part, I have reason to believe, that it yields 83 of this measure, and follow those that say, that a Vessel of two foot deep, long and broad, holds one *muid* of Water.

*The like to which hath been attempted here, and proposed to the *R. Society*, some years since, by Sr. *Chr. Wren*, who by the contrivance of a Rain-bucket had taken an account of all the Water that fell for a considerable time; and by his Weather-clock had, among other particulars, not only taken in the measuring of the quantity of Rain that falls, but also the time when it falls, and how much at each time. Which Instrument, if put into practice, would be of excellent Use, forasmuch as it may also serve, by some additions made thereunto by *M. Hook*, to record the weight of the Air, the drought, moisture, heat and cold of the Weather, the Sun shine, the quarters and strength of the Winds: And all this to be performed by one only motion, driving all the parts of the Instrument; which is therefore the more considerable, that it self records its own effects.

This

This being ſuppoſed, it follows, that a Veſſel, which contains 83 *muids* of Water, is able to furniſh in twenty four hours ſo much as will make an *Inch* of water run continually. And ſo, if a Conſervatory ſhould hold 3378 *muids* of water, it would furniſh for a whole year a ſufficient quantity to make an *Inch* of water run conſtantly: And if it were as big again, it would make run two, and ſo on more or leſs in proportion. But here I ſuppoſe an Equality in the running, though I am not ignorant, that the Conſervatory being full, the water will then run out with more velocity, and conſequently in greater quantity, than when 'tis near empty. But this being only to make the matter better underſtood, I ſhall not ſtand upon this preciſeneſs.

But then for the meaſure of the Rain and Snow-water, I ſhall tell you, that as to the Obſervations which I have made my ſelf of the quantity of ſuch water, I have found, that from *Octob.* 1668 to *Octob.* 1669, there had fallen ſo much of it, as amounted to the height of 18 inches 7 lines; and from the ſame Month of 1670 to the ſame Month 1671, there had fallen only ſo much as came to the height of $8\frac{1}{2}$ inches; and from *Januar.* 1673 to *Januar.* 1674, to the height of $27\frac{1}{2}$ inches. Of which, taking the *medium*, we have 19 inches end $2\frac{1}{3}$ lines.

This ſuppoſed, we muſt for our purpoſe meaſure or make an Eſtimat of ſome River, as it runs from its very ſource to a place where ſome Rivolet enters into it, and ſee, whether the Rain-water that falls about the courſe thereof, if it were put into a Conſervatory, would be ſufficient to make it run a whole year.

I have looked upon and conſidered the River of *Seine* in its courſe from the ſource of it unto *Ainay le Duc*, where enters a Rivolet that ſwells it. And this I ſhall take for the ſubject of the *Examen* I intend to make.

The courſe then of this River from its Spring to the ſaid *Ainay le Duc* is about three leagues long, and the ſides of its courſe extend themſelves on the right hand and the left about two leagues on each ſide, where there are other little Rivers that run another way: And, ſince that theſe Rivolets need Water to maintain them as well as the *Seine*, I will count but half that ſpace of the ſides, and ſay, that the place where the *Seine* paſſes, hath from its ſource to *Ainay le Duc*, three miles long, and two miles large. Whereupon I ſay further, if a Conſervatory were made of this bigneſs, it would be ſix leagues ſquare in ſurface, which being reduced to fathoms,

would,

would, according to the measure fixed above, make 31 millions and 245144 fathoms in surface. In this Conservatory imagine, that during a whole year there has fallen Rain to the height of 19 inches $2\frac{1}{3}$ lines, as was said before. This height of 19 inches and $2\frac{1}{3}$ lines gives 280 millions 899942 *muids* of water, or thereabout, according to the measure supposed.

All this Water thus collected in the quantity just now expressed, is that stock which is to serve to make this River run for a whole year, from its source to the place before-named, and which must also serve to supply other occasions and losses, such as are the feeding of Trees, Herbs, Vapors, and extraordinary swellings of the River whilst it rains, and deviations of the water running another way.

Concerning the measure or estimate of the water of this rising River, it would be difficult to find it just and precise, and to determine what quantity it furnishes. Yet so far as I was able to judge, it can have no more than a 1000 or 1200 inches of water alwaies running, compensating the lesser quantity it hath at its source with the greater it hath towards *Ainay le Duc*: The which I so judge by the comparison I make of these Waters with those of the River of the *Gobelins*, in the condition wherein it is towards *Versailles*, where it hath fifty inches of water, according to the measure taken of it. So that I esteem, it will be enough to allow twenty four or twenty five times as much to *our* River. For the Channel of it is to be four or five fathoms large, and for depth 'tis but shallow; it carries no Boats, and serves only to float down some loose Billets.

These particulars being thus supposed, I say, that according to the measures we have agreed upon, 1200 inches of water do furnish in twenty four hours, after the rate of 83 *muids* of water to an inch, they furnish, I say, 99600 *muids* of water; wherefore, for a whole year, which is near 366 times as much, they will furnish 36 millions 453600 *muids*.

This River then sends away within its banks, in a year, no more than about $36\frac{1}{2}$ millions of *muids* of water. But taking this quantity out of the 280 millions that are in the Conservatory above described, there will remain yet above 188 millions of *muids*, which amounts to almost five times as much, and which serves to furnish for the losses, diminutions, and other wastes, above taken notice of. So that there needs but the sixth part of

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the Rain and Snow-water that falls in a year, to run continually through the whole year.

I am well aware, that this deduction is not ſure; but who can give a ſurer? However ſuch as it is, I think it is more ſatisfactory than a bare Negative, as is that of thoſe, who pretend, it rains not enough to furniſh ſufficient quantities of water for the conſtant running of Rivers.

Now then, if theſe Rain-waters are ſufficient to make one River run, they may alſo ſuffice for all the reſt in proportion, conſidering eſpecially, *firſt*, what remains for waſte, which is ſuperabundant, and *ſecondly*, what little ſpace I allow to both ſides of the River's courſe, which is but of one league on each ſide. For, Rivers are not commonly two leagues near one another.

It may be objected, *that there are Countries where it rains but ſeldom, and ſomewhere it rains not at all, and yet there are conſiderable Rivers.* But I anſwer, that the Rivers of thoſe Countries, where it rains but ſeldom, do not run continually, being only big in Winter, but in Summer almoſt quite dried up. The reaſon of both which effects is, that they being near ſome high Mountains whence they come, the Snow that falls in abundance on thoſe Hills, and is melted afterwards, is able, as long as that water laſts, to make them run abundantly in Winter, leaving them dry when it ceaſes in Summer.

As for the Countries where it rains not at all, there are but few of them in the World. The *Torrid Zone* (where that may be more true than any where elſe) is a Climat abundantly moiſtned with Rains twice a year, and it may be more than theſe Northern Countries, at leaſt in greater plenty at certain Seaſons. But if there ſhould be any Countries where no Rain at all ſhould fall, that will not hinder the running of Rivers there, becauſe they may have their ſources in other Countries where it rains, as the *Nile* in *Egypt*, where it rains not.

A Letter of the Ingenious Mr. Jeſſop *of* Broomhal *in* York-ſhire, *containing a further account of Damps in Mines, promiſed in* Numb. 117. *of theſe Tracts.*

SIR,

IN order to give Mr. *Boyle* and you ſome ſatisfaction to your laſt Letter, I went to *Wingerſworth* this laſt week: That which I ſaw was little, becauſe a great part of the Pit was filled up; but I found two of the Colliars in the Pits adjoyning, who had been

ſcorched

ſcorched by the *fulminating damp* (the marks of which they yet carried in their hands and faces ;) and from them I received the greateſt part of my information.

The ſhaft of the Coal-pit is about fifteen yards deep ; the Soyl a ſtiff mire, ſhaly about the middle of the ſhaft, dry at the bottom (as they ſay, though I obſerved ſome moiſture about the middle) and without any quarry of ſtone ; the ſtones in the field about it are grit-ſtone : It lies almoſt at the bottom of a riſing ground, being incompaſſed with Hills on all ſides, except towards the Eaſt, or rather Southeaſt.

There are three Pits which lye almoſt in a direct line, the middlemoſt of which is that we ſpeak of. There is alſo a fourth, which ſtands a little higher than the reſt: They lye in this figure;

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From the bottom run four Binks, as they call them ; four yards wide, and forty yards long, except that in which they met the fiery damp, which wants four or five yards of its due length.

The Bink in which the damp is, is the fartheſt from the Air, which is communicated from the other Pits.

The Soyl of this Bink (as they tell me) is a ſtiff clay ; neither can they find in it the ſign of any Mineral, except Coal and Shale. The Coal, they ſay, is abſolutely free from the *Pyrites*, with which moſt of our Coals are infected.

The Bink in which the damp is, was wrought forward twenty yards on *Whitſon*-monday laſt, when *George Michell* (one of my informers) going in to fetch ſome of his tools with a Candle in his hand, and coming within four or five yards of the further end, found himſelf (on a ſuddain he knew not how) invironed with flames. His face, his hands, his hair, and a great part of his cloaths were very much burnt : He heard very little noiſe, although one *Edward Michell*, who was working at the ſame time in another Bink, told me, That both he and thoſe that ſtood above ground, heard a very great one, like a clap of thunder, and that the Earth ſhaked ; ſo that he was affraid the roof would have faln in, and buried him.

This being the firſt accident of this nature, thoſe without ran, in a great amazement, with their candles in their hands, to ſee what the matter was ; which were twice extinguiſhed, but held-in upon the third lighting : They ſaw nothing, but met with an intolerable ſtench of brimſtone, and an heat as ſcalding as an Oven

half heated (for that was their expreſſion;) which forced them very ſpeedily to quit the place.

Notwithſtanding this, they wrought forwards for about three weeks, and carried it on to betwixt thirty and forty yards, until one *Henry Turnelly* met with the ſame accident, which had formerly befaln *Michell*, and *Michell* had alſo the misfortune to have his ſhare in this: For, being by chance under ground, at the mouth of the Bink, he was ſhot forth for about two or three yards, and had his head broken, and his body bruiſed againſt the further ſide.

About a week after, *Edward Michell*, another of my informers, adventuring in again, met with the ſame misfortune, and was worſe ſcorched than any of the reſt.

The things I chiefly took notice of, were theſe:

1. That thoſe who were in the Bink whilſt it was fired, never heard any more noiſe than that which is uſually made by a flaſh of Gun-powder in the open air, although thoſe in the other Binks, and out, heard a very great one.

2. It ſhot off the Turne at the mouth of the Pit, and ſmall Coals with other rubbiſh from the bottom, into the air to a conſiderable height.

3. They could perceive no ſmell before the fire, but afterwards a very ſtrong ſmell of brimſtone.

4. They uſed to go with their candles low, as neer as could be to the bottom, becauſe they perceived the vapour to lye towards the roof; which, if they held their candles higher than ordinary, they could ſee deſcend like a black miſt, and catch hold of the flame, lengthning it to two or three handfulls; which would nevertheleſs burn after the uſual manner without any further miſchief, if they ſuddainly held down their hands cloſe to the ground.

5. The flame would continue in the Vault for two or three minutes after the crack: The laſt time, which was the moſt violent, they thought it continued for about half a quarter of an hour.

6. The colour of the flame was blew, and very bright, ſomething inclining towards green.

7. Although they told me, they were ſenſible of no ſmell before the kindling of the Vapour; yet the Colliers cloaths, that worked in the adjoyning Pits, ſmelt very ſtrong of brimſtone; which makes me ſuſpect all the Pits to be infected, although the air ſecures them from miſchief. Their inſenſibility I aſcribe to cuſtome.

To your *Quære's* * I answer as followeth: * What most of these *Quære's* were, suggested by Mr. *Boyle*, may be easily collected from the Answers.

To the *first* and *second*: That damps are most generally observed to come about the latter end of *May*, and to continue during the heat of Summer; and in those places, which have damps all the year long, yet they observe them to be most violent at that season: And I could meet with no other certain rule for any periodical returns except this Annual; although it be certain, they do often return in the same Summer.

To the *third*: I never heard of damps that kindled of themselves, although I have been told, that in some places they have been kindled by the motion of the Sled, in which they draw their Coals.

To the *fourth*, *fifth*, and *sixth*‖: I can say nothing, because the Pits were stopt; but I rather suspect it to be a sluggish vapour resting in the Vault, than otherwise, because the motion of the air cures it not only here, but in other places.

‖ These three *Quære's* were; 1. Whether the fumes that come visibly out of the mouth of the Pit, will be lighted by a candle or torch? 2. Whether, if a piece of a plate, or any other flat piece of clear copper, be held for a competent time over the mouth of the Pit when the fumes ascend, any blewish or greenish discoloration will be made on the surface of the Mettal? 3. Whether a light body of a convenient shape, being tyed to a string, and held over the mouth of the Pit, will be carried up and down with a briskness that may argue an unusual wind, or current of vapours, coming from beneath?

To the *seventh*: Damps generally are held to be heavier than the Air; but this was manifestly lighter, for it lay towards the top of the Bink.

To the *eighth*: Upon the breaking of the fulminating damp there proceeded a dark smoak, of the smell and colour of that which proceeds from Gun-powder fired.

To the *ninth*: Many Damps are seen, but many also are not seen; which whether they be visible or no, is hard to tell. But I suppose, all would be visible, had we a convenient light to view them by, because, be they either thicker or thinner than the Air, that density or thinness will occasion a refraction, and that must needs render them visible.

To the *tenth*: Some Damps will quite extinguish all those fires that are let down into them, be the never so many successively, or never so great; and fire is observed to be so far from curing, that it often creates Damps in places not otherwise subject to them. In-

deed they are a present remedy, if you can so order them as by their help to make a circulation of the Air through the infected place, otherwise they do hurt; and those groves wherein they are forced to break their rocks by the help of great fires, are seldome free from Damps.

To the *eleventh*: Men usually work in places infested either by the fulminating or other Damps, after they suppose the Vapour spent.

To the *twelfth*: Damps are common both in dry and wet grounds; but I cannot tell in which most.

To the *thirteenth*: Damps are observed to be most pestilential, and to kill the suddainliest, that are in groves not stirred for many years; especially if such groves have formerly had great fires in them.

To the *fourteenth*: The general opinion of our workmen is, That there are some Damps which kill by reason of the noysome steam, and others meerly by want of air: Which latter opinion I have heard disallowed by the more experienced sort. For they say, there is no grove that wants Air, be it never so deep; but the air stagnating in very deep groves or pits, the grosser parts must needs at length separate themselves by their own weight, and subsiding to the bottom, there corrupt, and consequently get malignant qualities, especially in the Summer time, when the Sun promotes the fermentation. Besides this, the standing Air being in a short time filled with the Vapours arising from mens bodies and the steams of candles, and passing so often through the lungs of the workmen, is quickly rendred unfit for that use (whatsoever it is) to which respiration is accommodated: And this they take to be the most frequent cause of ordinary Damps.

To the *fifteenth*: Damps will often follow the water, and particularly this sort of fiery damp, if I am rightly informed.

An Account of some Books.

I. *A Philosophical Discourse of EARTH, relating to the Improvement of it for Vegetation and the Propagation of Plants*: *By* J. Evelyn *Esq*; *Fellow of the R. Society.* London, *printed for* J. Martyn, *Printer to the said Society. A.* 1676, *in octavo.*

THis instructive and useful Discourse was presented by the Ingenious Author thereof to the *R. Society* in two Lectures, *viz. April* 19. and *May* 13. of this very Year.

In it he first describeth what he means by *Earth*; then endeavors

vors to ſhew the ſeveral ſorts and kinds of Earth, as they reſide in their ſeveral Beds, together with the indications, by which we may diſcover their qualities and perfections; and laſtly, how we may beſt improve it to the Uſes of the Husbandman, the Forreſter, and the Gardener; which is indeed of large and profitable extent, though it be but poor and mean, compared to Mines of Gold and Silver.

In the *ſecond* part he not only takes notice, among the reſt, of the fitneſs of our *Senſes* in giving their verdict of the ſeveral qualities of Earths; but alſo acquaints us with the Microſcopical examination he hath made of divers ſorts both of Earth and Soils or Dungs; thereby encouraging others to inquire and obſerve, whether the very fineſt Earth, and beſt of Moulds, however to appearance mixt with divers imperfect bodies, do not conſiſt more of *Sandy* or *Salin* particles, than of any other; and by ſuch inquiry to find out the *principles* of Vegetation: Suggeſting further ſeveral Quære's belonging to this argument; as, how far *Principles* might be multiplied and differenced by alteration and condenſation? Whether Earth, ſtript of all heterogenity, retain only weight and an inſipid ſiccity? And whether it produce or afford any thing more than embracement to the firſt rudiments of Plants; protection to the roots and ſtability to the ſtem; unprolific, as they ſay, till married to ſomething of a more maſculine vertue, but otherwaies nouriſhing only from what it attracts, without any active or material contribution? &c.

In the *third* part he teaches *firſt*, How we may *improve* the beſt Earths, and apply remedy to the worſt, only by labour, ſtirring, ventilating, ſhading and repoſing; which being the leaſt Artificial, approach the neareſt to Nature: Where he notes, among many other excellent particulars, that the bare raking and combing only of a bed of Earth, now one way, then an other, as to the regions of Heaven and polar Aſpects, may diverſify the annual production. To which he ſubjoyns ſeveral *Mechanical* aids, (without *ſtercoration*) whereby the Soil may be rendred of a very extenſive capacity for the entertainment of forreign and un-common Plants: Commending *Irrigation* or Watering as one of the richeſt Improvements that ever was put in practice, eſpecially where fat and impregnate waters may be had, without grittineſs, or being over-harſh and cold: Teaching alſo the cure of wet and boggy Lands, and ſuch as are cold and dry, hungry and hot, too light and over-rank; and ſuch as become unfruitful by the neighbourhood of other Plants, de-

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vouring the juyce of the Earth; or by the dripping of ſhadowy Trees.

Secondly, he delivers, what farther advancement we may expect from *Stercoration* or manuring the ground with *Compoſts*, and diſcovers to us the qualities latent in their ſeveral ferments, and how to apply them by a skilful and philoſophical hand, without which they do alwaies more hurt, than good. Here, he *firſt* enumerates their ſeveral kinds, *viz.* from Animals, Vegetables, and of things promiſcuous, and whatever is apt to rot and conſume in any competent time, and is either ſalt, unctuous or fatty: To which he adds impregnating *Rains* and *Dews*, Cold and Dry Winters with ſtore of *Snow*, which he reckons equal to the richeſt manures, impregnated as they are with Celeſtial Nitre. *Secondly*, he notes, what it is we chiefly ſeek for, and expect from Compoſts: Here he obſerves, that amongſt theſe materials we may detect the cauſes of fertility more eminently than in other ſubſtances, partly from their *fixed Salts*, or ſome virtue contain'd in them, or rather drawn from without, and imparted to the exhauſted and defective Earth; and that by ſuch a proceſs, as, by converting them into a *Chyle*, as 'twere, it facilitates their being inſumed, aſſimilated, and made apt to paſs into nouriſhment promoting Vegetation. *Thirdly*, How to treat Compoſts, ſo as to render them fit for our ſervice: Which he takes to be a difficulty worthy the heads as well as the hands of the profoundeſt Philoſopher; ſince it requires a more than ſuperficial knowledge and penetration into cauſes. How skilfully he hath alſo acquitted himſelf of this part, the Curious Reader will beſt underſtand by peruſing and conſidering the Diſcourſe it ſelf; from which we are unwilling any longer to divert him by an imperfect account.

II. *A Deſcription of the Iſlands and Inhabitants of* Feroë, *&c. written in* Daniſh *by* Lucas Jacobſon Debes *M. A. and Provoſt of the Churches there: Engliſhed by* J. S. *Doct. of Phyſ. in* 12°.

THE Iſlands deſcribed in this Book, are 17 in number, ſubject to the King of *Denmark*, lying under 62 deg. 10 m. of North-latitude: Concerning which the Deſcriber gives an account of the Fertility of their Lands and Waters, and of their Inhabitants, beſides their Government, Churches, Schools, &c.

Among the Obſervables of theſe Iſlands are theſe following;

1. A dangerous Whirl-pool, near one of them, called *Monk*; which is moſt miſchievous to Ships in ſtill weather, but avoidable with a freſh gale of wind.

2. Abun-

2. Abundance of Herrings sometimes found on the top of a very high Mountain, thought to be carried thither by a kind of violent Whirl-wind, which falling on the Sea is said to take up an incredible quantity of water, so that one may see vast cavities in the Sea, till the water meet again; and what Fishes are then in that space of water, are raised up by the force of that wind.

3. The Rocks, of which these Islands consist, are said to be here and there Magnetical, on which if a Sea-compass be set, it will very much vary in some places to the East, in others to the West. And at the South of one of these Islands, call'd *Suderoe*, there is another Whirl-pool, in the midst whereof stands an high Rock, on which a Compass being put, it turns round, and is so spoiled, that afterwards it is useless, unless the Needle be touched anew by a good Load-stone.

4. The ordinary declination of the Needle on *Feroë* is by our Author affirm'd to have been 13.*d.* 13.*m.* to the *North-west*, *A.* 1659.

5. The Tides are strongest here, three daies before and three daies after the New and Full-Moon; and a Noarth-east and a South-west Moon, make highest water in all the principal streams of these Islands. In the other less considerable ones, 'tis high-water at different hours, in some before, in others after, the ordinary time.

6. The famous Whirl-pool or Sea-gulf under *Norway*, call'd the *Maal-strom*, is by *Kircker* and others erroneously said to run down under the Land of *Norway*, and run out again at another Sea-gulf within the *Sinus Botnicus*; as this Author undertakes to prove, *p.* 54.

7. The Explication of the Tides, which by others is thought so difficult, seems to our Author very plain and easy, as consisting, in his opinion, in nothing but a meer reciprocal motion, between the Continents, from East to West, and from West to East, and that in great waves: Which he endeavors to evince by several arguments; *p.* 65. Those of *Feroe* call the Ebb and Flood, *East-* and *West-fall*; the *East-fall* is that, which with its waves falls on the East of *Norway*; *West-fall* that, when the Sea falls back to the VVest-part of *Green-land*: The East-fall making low water in *Feroe*, as falling to the East of *Norway* and making there high water; but the West-fall making high-water in *Feroe*, because when the Flood falls back from the VVest of *Norway*, the waves arise and form themselves higher and higher against *Feroe*, according to the nature of waves; which, *he saith*, appears by this, that at the East of *Feroe* the water rises but three fathoms, but at the VVest, seven; the distance being

but

but 40 miles in longitude. Here the Author wishes, that an exact description might be made of the VVest-coast all along *Europe* and *Africa*; and, on the opposit side, of the whole East-coast of *America*, and afterwards in the *Pacifick Sea*, all the VVest-coast of *America* and the East-coast of *Asia*, as far as it lies exposed to the Sea; as also when it is highest water at the Points and in the Bayes; besides, how high the water riseth, and how much it falls in every place; and what is their longitude. And further, that these things might also be diligently observ'd about the *Islands* over the whole VVorld, or as far as is possible.

8. In this Author's opinion, the Stream which comes from the Channel of *England*, runs into *Baltick* or East-Sea, and out again, though inperceptibly, and all the East-Sea hath, *saith he*, its ordinary Ebb, and Flood; which he not only undertakes to prove by the stream of the *Sinus Botnicus*, but adds, that it may easily be perceived by the little Current between the *Falster* and *Zealand* in *Denmark*, which, he affirms, does orderly run East and VVest, absolving its Ebb and Flood in *six* hours.

9. The manner how Ebb and Flood is effected, depends, in our Author's opinion, (common to many others) on the Moon; this Planet both helping and regulating the motion of the Sea: On which argument he is very large.

10. The Country of *Feroe* is provided with many well-tasted and wholsom Fountains, springing on high Hills.

11. In *Feroe* there are no Trees, but only some shrubs of *Junipers*; abundance of Turf compensating that defect.

12. The Air of *Feroe* is very temperate, in VVinter as well as in Summer, though it lieth so far North; it seldom freezing there a month together; and the frost then being not so hard as to produce Ice in the open Inlets: And Horse and Sheep go into the Fields during the whole Winter.

13. No Thunder heard in *Feroe* all Summer, but in the Winter there is, which commonly is accompanied with great storms and rains.

14. The Air is wholsom there, free from contagious Diseases; which the Author saith are never found there, except they be brought in by infected people. No Agues observed there, nor Small-poxes, except they come in from forreign parts. Only they are troubled with Rheums, Dysenteries, the Scurvy, and sometimes the Leprosy.

15. On

15. On the Sand near the Sea-side is found in some places a kind of pellucid Stones, so hard that with them you may write on Glass: They are white, or of a blewish white; others yellow: Some of them may be so well polisht, that they serve for Rings: Of these Stones it is thought, that they grow on the Cliffs, and are washed off by the Sea-waves.

16. No *Grain* will come to maturity there but *Barley*. They abound in Pastures; and in several places Grass is so plentiful and juicy, that Oxen feed thereon both winter and summer, growing sometimes so fat, that one Ox, not big of growth, yields an hundred pounds of Tallow: Which rich pastures our Author observes ever to lye to the North-East and North; as he notes also, that in *Iceland* the North-part is more fertile in Grass and Cattle, than the South; and that *Green-land* likewise is found to be much more given to Grass on the North-East side, than on the West-side. Whether this be to be ascribed to the Snow, which comes from the North and North-East, and is stored with Nitre, (the reputed cause of fertility;) is considered by our Author.

17. They dung their ground with Sea-weeds, laid on heaps to rot, whereby they get good crops of Barley.

18. Their *Plants* are *Turnips, Carrets, Colworts, Lettice, Cresses, Penny-royal, Scurvy-grass, Beccabunga, Sorrel, Angelica, Tormentil* and *Radix Rhodia*. Of these, in time of dearth, they eat the roots of *Angelica*: With *Tormentil* they tann their Hides; and with the *Radix Rhodia*, chiefly, they cure the Scurvy.

19. When extraordinary Snow falls, and Shepheards are not present to drive their Sheep under shelters, the sheep gather themselves close together; and the Snow so covering them, that they cannot be seen for a while, at last the Country-man perceives a damp arising from the Snow by reason of their warmth, and so goes and makes a passage for them to get out. Sometimes when they cannot be found by reason of excessive Snow, our Author saith, that now and then they remain a whole month under the Snow, eating the grass by the roots, and the wool of one another. Their Sheep for the most part are white in the North-part, but black in the South; and being brought white from the North to the South, they will change colour; yet so as to grow first spotted about their legs; then on their thighs, then under their bellies, and at last all over.

20. This Country is well stored both with *Land-* and *Sea-Fowl*, whereof some flie away towards winter, others stay the

whole year. Thoſe that ſtay, are *Pigeons*, *Stares*, *Grillings*, *Sparrow-hawks*, *Ravens*, *Crows*; thoſe that fly away, are *Snipes*, and ſome VVater-fowl. Here the Author mentions a *Raven*, taught by him to ſpeak; which as long as he would teach him, would not go from him, though it laſted two hours; and what he was taught in the day time, he repeated early in the morning, putting the ſyllables together, till he could ſpeak out the whole word. Amongſt the VVater-fowl he mentions one, which he ſaith is never found on the land, and is called *Imbrim*; the Inhabitants taking it to be the *Halcyon* or *Kings-fiſher*; though it doth not agree with the deſcription, commonly made of that bird, *viz.* That it is no bigger than a Sparrow, and is blew, and hath other qualities not at all agreeing with thoſe of this fowl; which is bigger than a Gooſe, having a long neck, and a pretty long beak; is grey on the back, checquer'd with white ſpots; its neck is alſo grey, ſomething whitiſh down towards the breaſt, having a white ring about the middle of the neck. 'Tis never found on land; for its feet ſtand too much back, and are ſo weak, that it cannot go with them: Beſides, its wings are ſo little, that it can fly but little. It hath a hole under each of its wings, capable to hold an Egg, wherein the people ſuppoſe it hatches its eggs; neither is it ever ſeen with more or leſs than two young ones.

21. For *Fiſh*, they have ſtore of *Trouts*, *Cods*, *Whitings*, *Flounders*, *Pilchards*, *Seals*, (which laſt like VVhales, give ſuck to their young ones;) alſo a ſort of *Whales* call'd *Grind-Whales*, of which the biggeſt are but five ells long, which come in great numbers under the land: They have ſhort heads, and little eyes, a black skin with a white ſtroke under the belly, and are pretty fat; the head being almoſt nothing but fat, and the body having a palm thick of fat. They partly melt the fat of the whole, to make *Train-oyl*, ſalting the reſt with black-ſalt, to uſe it as Bacon. This ſalt they prepare of Sea-weeds, which they dry and burn to aſhes. They dry and eat the fleſh when 'tis freſh, looking and ſmelling like Beef; and what they cannot ſtrait conſume, they cut into long pieces, and hang them up to dry in the wind, eating it afterwards like Hung-beef. Foraigners ſometimes pickle part of the tayl, which taſts much like Neats-feet: VVhence the Inhabitants take theſe VVhales to be, and call them, *Sea kine*. But beſides this ſort of VVhales, they have two ſorts more, called the *Roar* and *Witch-Whale*, on which the Inhabitants dare not venture (they are ſo great and dangerous;) but they drive them away, *ſaith my Author*, by the virtue of *Caſtoreum*, which

uſually

uſually they carry in the head of their Boats, boring a hole in the wood, and putting of that ſubſtance in it, and ſtopping it with a peg: Others incloſing it in a piece of wood, to which they faſten their fiſh-lines, and carrying it always with them in their Boats. Now when theſe Whales come under thoſe Boats, or that they caſt that piece of wood upon it, they ſink to the bottom like a ſtone, as if they could not endure the ſmell of the *Caſtoreum*.

So much of the *Natural* Obſervations; the *Moral* and *Political*, as not belonging to the deſign of theſe Tracts, we leave here untouched.

III. *The Gentleman's Recreation in four Parts*; *viz.* Hunting, Hawking, Fowling, Fiſhing. *Collected from Ancient and Modern Authors, Forreign and Domeſtick, and rectified by the Experience of the moſt skilful Artiſts of theſe times.* London, *in octavo*, 1674.

HAving given a Breviat long ſince (*Vol.* 3. *num.* 37.) of the Sieur *Salnove*, the chief Maſter of the Royal Game in *France*; (theſe Games containing much of *Natural*, *Artificial* and *Experimental* Philoſophy, and aſſerting Man's dominion over Animals;) I think it may be expected, that I ſhould take notice of this our Complete *Engliſh* Author: ſince *England* hath a Reputation for Forreſts, Chaſes, Parks, Lawns, Champian-fields, Plains, Hills and Boſcage, as alſo for expert Hunters, excellent Horſes, and no leſs excellent Dogs of all ſorts, proper for every kind of Game.

It was in the Age of *Auguſtus Caſar*, that *Gratius*, their beſt Cynegetical Poet, compared the *Britiſh* Dogs for courage and ſtout performance with the *Moloſſian*, and for craft or skill with the *Athamanian*, *Theſſalian* and *Epirote* Dogs, which, in thoſe differing faculties, were the beſt in the World, that were then known at *Rome*, where from remoteſt parts they were often tried in the Theatre.

Quid freta ſi Morinum dubio refluentia Ponto
Veneris, atque ipſos libeat penetrare Britannos?
O quanta eſt merces, & quantum impendia ſupra!
Si non ad ſpeciem, mentituroſque decores
Protinus, hæc una eſt catulis jactura Britannis,
Ad magnum cùm venit opus, promendaque virtus,
Et vocat extremo præceps diſcrimine Mavors,
Non tunc egregios tantùm admirêre Moloſſos;
Comparat his verſuta ſuas Athamania *fraudes,*
Acyruſque, Pheræque, *& clandeſtinus* Acarnan.
Sicut Acarnanes *ſubierunt prælia furto*
Sic canis illa ſuos taciturna ſupervenit hoſtes.

And the race of Bul-dogs in *Somerſetſhire*, to this day, are obſerved to agree perfectly with this Poets deſcription, for unpromiſing appearance, invincibleneſs, and ſilent ſubtilty, though mortally bruiſed and wounded: Whether from the ſoyl, the climate, or the continual race. And the effect of our former skill, courage, and induſtry in hunting, herein appears, (which I muſt mention for the Honour of this great

Iſland;) That our Anceſtors have made a clear riddance of Bears, Wolves, and all other furious beaſts, which are apt to aſſault Mankind. And hereby we have had the more leiſure, to fit our Dogs for all ſorts of *Engliſh* Game; to chooſe tall and deep-mouth'd Hounds for Woodland; little Beagles for ſmooth Plains; Hounds of a middle ſize, where the Country is partly champian and partly encloſed; light, ſlender and fleet Hounds, where the Country lies open for the fleet hunting-Horſe. Every where they are provided of Hounds fit for the Country; and withal, are every where curious to conſort the mouths of every Kennel for a rural or ſylvan Muſic, agreeable to chear up the Hunters. And 'tis believ'd, that the *Engliſh* Dogs of all ſorts, for the Hare or for the Hart, and for any Game which this Iſland affords, are as good Dogs as can be found in any Country, to us known. In all which reſpects, both of Safety and of Pleaſure, of healthful exerciſe and of harmonious Hunting, we may here juſtly call it *The Gentlemans Recreation.* And if we uſe it as a Recreation, moderately, in fit ſeaſons, and at due intervals, Hunting preſerves bodily health and alacrity in our Spirits; prompteth to riſe early, and to endure the dews of the Morning, and the caſualties of harder weather. It gets a ſtomach for ordinary viands, and renders them more pleaſant than haut-gouts. It hardens againſt effeminacy, as they report of *Hippolytus.* It enables to ſit well and firmly on Horſeback; and ſtrengthens the back for the great Saddle, and for greater ſervices, when publick occaſions require them. Thus much for the Authors Title, and for *Engliſh* Huntſmen, and for *Britiſh* Horſes and Dogs. I ſhall only add, that about three hundred years after *Gratius*, *Nemeſian* gives the precedence to *Britiſh* Greyhounds for velocity, *v.* 124. *Cynegetic:*

——— *Diviſa Britannia mittit*
Veloces, noſtrique orbis *venatibus aptos.*

Noſtri Orbis, ſaith he, a *Carthagenian*, but then reſiding at *Rome.* For ſome Ages after that *Julius Cæſar* entred *Britain*, the Hounds of this Iſland were ſo little known at *Rome*, that it was eſteemed and called *Orbis Alter*; for ought they knew, larger than our lately diſcovered *America.* Neither could the fleetneſs of *Britiſh* Greyhounds be tried in their Theaters; nor is it certain, that the *Romans* or *Britains* were then much addicted to Courſing, or could ſoon know the worth of thoſe Greyhounds: Much leſs, that they ſhould then know the *Iriſh Greyhound* or *Wolf-dogs*, *Canes Scotici* (the *Iriſh* were called *Scoti* in former Ages:) Which for ſhape, ſize, fleetneſs, courage and execution, (taking all in one) are the goodlieſt Dogs that we can hear of. And 'tis hoped, the *Engliſh* and *Iriſh* will, in a ſhort time, deſtroy the routs of Wolves there, for the benefit of their Poſterity, as our Forefathers have done for us in *England*, *Scotland*, and *Wales.*

2. For *Hunting*, our accompliſht Author ſhews us the Ancient hunting Notes, for winding the Bugle horns, with the additions of Mr. *Marſh*, Horner, on *Holborn-bridge*, who taught him to *blow* a Horn, and

and the Note *. He explains Hunters Terms. He teaches to chooſe Hounds, by their colour, and other marks, *p.* 8, 9; as alſo the choice of Dog and Bitch for good Whelps, *p.*10. To order a Bitch and Whelps. To enter young Hounds to huut the Hart, 11. The nature, rutting, mewing, coats, colour and hunting of Harts, 13, 24. The marks to know an old Hart, 16. To ſeek a Hart in his haunts, according to the ſeaſon of the year, 18; drawing in the ſprings, 19; in high Woods, 22; and when loſt the night before, 21. To rouze a Hart, to caſt off the Hounds, 22; the incredible ſubtilties of a Hart, when hunted, *p.*24. To kill a Hart at Bay; to break him up; to reward the Hounds, 29. To hunt the Buck, 30; the Roe, 31; the Rayn-deer, 33; the Wild goat, 34; the Wild bear, and in proper terms, 36; the Hare, her wonderful ſubtilty, 39, 40. To order Hounds to the Hare: To find, ſtart and chaſe her, and what ſeaſon of the year beſt for Hare-hunting, *p.*45. Of Cony-hunting. To hunt the Fox and Badger, above ground; what Inſtruments for digging, *p.*55. Of Otter-hunting, 56. Dogs diſeaſes and hurts, and their Remedies, *p.* 59. Of Breeding, feeding, dieting, chooſing, kennelling a Greyhound; and of Courſing, 65. The Laws of Hunting, *p.* 69.

* The Notes are but theſe three,

——, ȯ, ȯ;

which by ſtops, and changes, and redoublings are ordered to ſignifie, 1. To call the Company in the morning: 2. The ſtroaks to the Field: 3. To uncouple the Hounds: 4. When the Hounds hunt game unknown: 5. A Recheat when the Hounds hunt a right game: 6. The double Recheat: 7. The treble, or Sir *Hewits* Recheat: 8. The Earthing of a Fox, if recoverable: 9. If not, to call away: 10. The death of a Hare: 11. The death of a Buck: 12. The death of a Stag, or Hart: 13. The death of a Fox: 14. The call for a Keeper in a Park or Foreſt: 15. The prize of a Hart Royal: 16. The ſtrokes for the Terriers, when the Fox is catched: 17. To draw the Company out of the Field: 18. A Recheat or Farewel at parting.

He admires the ſubtilty of theſe Beaſts of Chaſe; and no leſs the Sagacity of Dogs, who do never leave the game, but follow it through innumerable changes, varieties of other ſcents, even over or in the water, and into the earth. How ſoon a Dog will fix his eye on the beſt Buck in the herd, ſingle him out, and follow him; and him only, through a whole herd of Raſcal game, and leavs him not till he kills him, *p.*1, 2. He ſhews all along what crafts the *Beaſts* uſe to defend themſelves, (whilſt *Men* raiſe armies, and bend all their wits, valour, and engins of Art, to deſtroy one another,) and *p.*1, 2, he inſtanceth the *docibleneſs* of Dogs, as *admirable*, ſaith he, as their *underſtanding*: For as a right Huntſman knows the language of the Hounds; ſo the Hounds know the language and meaning of one another, as perfectly as we can diſtinguiſh the voices of our acquaintance from ſuch as are ſtrangers. And he gives his ſentiment freely, That no Muſic can be more delightful, than a pack of Dogs in full cry, to a man whoſe heart and ears are *ſet* to the tune of each charming Inſtrument, *p.*2.

He is in all his Treatiſe chaſt and vertuous, and interſperſeth grave admonitions upon all fit occaſions; and ſeriouſly inviteth to this roy-

al,

al, noble and healthy practise, highly prized in all Ages, *p.*1; trayning up Youth for manly exercises in their riper age, preserving and increasing strength and activity; diverting from the besotting sensualities, and the bewitching debaucheries of a *lazy life*, wasted in Wine and Bawderies, which fill the Body with more diseases than a sickly Hospital, saith he, *p.*7.

2. Of *Hawking*, at the entrance, He can hardly take himself off from admiring the nimble Musicians of the Air, the heavens aery Quire, which warble forth such curious notes, as puzle Art to imitate, saith he, *p* 76. Of the heavenly ditty of the ascending *Lark*, which would scorn to tread on the dull Earth but for necessity. Of the *Black bird* and *Thrush*, contending who shall bid the best welcome to the fragrant Spring. The clearness of the *Nightingal*'s Airs, the sweetness of her Descants, her natural risings and fallings, her doublings and redoublings, *&c.*76.

He distinguisheth the long-winged from the short-winged *Hawk*, explaineth the Falconers terms, treats of the long-winged, and first of the *Haggard Falcon*, compared with the *Falcon-gentle*, *p.* 81. more fully *p.* 121. The ordering the Haggard-Falcon, with rules how to remedy her carrying, and other ill qualities. How to know the nature and disposition of several Hawks, and what must be observed from thence, *p.*89. Of a *Falcon*, *p.*91. The manning, luring, flights and mewings, *&c*, of a Falcon, *p.*94. her Bathing, when lately reclaimed, and how to make her flying, and to hate the check, *p.*98. To enseam her with her castlings and scourings, *p.*100. General Instructions for an *Ostrager* or *Falconer*, *p.*94 more fully, *p.*105. Of the *Rammage-Falcon*, *p.*107. To hood a Hawk, to make her know your voice, and to be bold and adventurous, and to know the Lure, to make her flying. A flight for a Haggard, *p.*108.113. To make a Soar-Falcon, or a Haggard kill her game at the very first, *p.*114. A remedy, when she takes stand in a Tree, and when coy and proud through pride of grease, and when she will not hold in her head. To continue her in her high flying, *p.*110, 111, 116. A flight for the *Hern*, *p.* 119. The good shape and properties of a Haggard, compared again with a Falcon-gentle, *p*121. Of the *Barbary Falcon*, *p*124. The *Gerfalcon*, 124. The *Saker*, 124. The *Lanner*, *Lanneret*, and *Tunisian*, *p.*128. Of *Merlin*, *p.*131. Of the mewing of Merlins, Falcons, Gerfalcons, or Mylions, at stock, and at large, and which is the best way of mewing, *p.*133. Of the *Hobby* and *Jack*, and the way, or manner of Dareing, 136.

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3. Of *Fowling*: He notes, that *Water-fowl* are in their own nature the ſubtileſt and wiſeſt of Birds, that they ſeem to keep an orderly and well-governed Camp, having Scouts on land afar off, Courts of Guards, Sentinels, and all ſorts of other watchful Officers, ſurrounding the body, to give an alarum to any approach of ſeeming danger, *p.* 178: Yet theſe may be taken by them that know it, and all other Fowls and Birds by art, either by enchantment or enticement; by winning or woing, by pipe, whiſtle or call; or elſe by engines. Of Water-fowl, whether long-legged, and divers or waders, or web-footed and ſwimmers. Curious Notes of their haunts, of greateſt moment for the Fowler to underſtand, *p.* 179. What Nets for great fowl, and the readieſt way to take them; what Nets for ſmall fowl. Of Lime-twigs; great or leſſer Springes. The beſt Fowling-piece, and the Stalking-horſe, *p.* 188. To take all manner of Land-fowl by day or by night, 191. *Bat-fowling*, 194. The Day-net, 195. To take Hedg-birds by Lime-twigs, 196. To make the beſt Bird-lime, 200. To take Land or Water-fowl with baits, 202, and to recover Fowl thus entranced, 204. Several ways to take Pheaſants, *ibid.* Nets proper for them. To drive Pheaſant Powts into the Nets. To take Pheaſants by a Lime-buſh. The Seaſons for Nets or Lime. Several ways of taking Partridges, by Nets, engine, driving or ſetting, *p.* 211. To take Rayls, Quails, Moor-poots, &c. 218. To elect and train a Setting-dog, 219, and a Water-dog, with his uſes, 222; their Diet, &c.

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Pliny,

Pliny, *Rondeletius*, *Gesner*, *Johnston*, or *Aldrovandus*, or any other of the ancient or modern Halieutical writers. All is found Philosophy, Art and Nature, matter of Fact and confirmed by much experience.

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ERRAT.

Pag 443. lin. antepen. r. *hole* for *whole*, p. 445. l. 24. r. *sickish*, p. 446. l. 9. r. *that which* was, p. 448. l. 21. r. *and* for *end*, p. 453. l. 2. r. *collected*.

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PHILOSOPHICAL TRANSACTIONS.

December 27. 1675.

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Ten New Experiments, made and communicated by the Honourable Robert Boyle *Esquire, about the Weakned Spring and some Un-observ'd Effects of the Air: Where occurr not only several Tryals to discover, whether the* Spring *of the* Air, *as it may divers wayes be* increased, *so may not by other wayes than* Cold *or* Dilatation *be* weaken'd; *but also some odd Experiments to shew the* Change of Colors *producible in some Solutions and Precipitations by the Operation of the* Air. *Some Experiments made in the* Air-pump *upon* Plants; *directed and tryed by the same persons, mention'd in* Numb. 119. *An Account of some Books:* I. Francisci Willughbeii *de Midleton Armigeri, è* Reg. Societate, *ORNITHOLOGIÆ Libri tres, &c.* II. *The Comparative Anatomy of the TRUNCKS of Plants, together with an Account of their VEGETATION grounded thereupon, by* Nehemiah Grew *M. D. and Fellow of the* R. Society. III. *The ROYAL ALMANACK, &c. by* N. Stevenson, *one of his Majesties Gunners.*

New Experiments about the weaken'd Spring and some un-observ'd Effects of the Air: Made and communicated by the Honourable Robert Boyle *Esq.*

—— AS for the not yet communicated Tryals that I made in prosecuting my Design of discovering or observing some *latent* Qualities of the *Air*, I will not deny you some of them, as imperfect as they yet are, but will venture to send them you, as my Notes or my Memory suggests them to me; not only, because without being compleated they may be fit enough to countenance

ſuſpicions (for you know, that I do not call them ſo much as *opinions*,) but for a weightier inducement, to be told you at the end of this Paper.

The two chief things aimed at in the imperfect Attempts I now ſend you, were to diſcover; *firſt*, whether, as ſome Corroſions of Bodies do in cloſe Veſſels *increaſe* the Spring of the Air (as I long ſince noted them to do,) ſo ſome other Corroſions may not, by a contrary or ſome other way, *weaken* the Spring of the Air; and *next*, whether in ſome Solutions and Precipitations the Air on the account of ſome unobſerved Quality may not be found to produce ſome *Phænomena* not yet taken notice of.

In order to each of theſe Enquiries, I ſhall mention a few Tryals, though without curiouſly ſorting them, becauſe ſometimes in the ſame Experiment both thoſe Attempts were jointly proſecuted.

You may remember that in ſome of my formerly publiſhed Tryals I acquainted you with an odd *Phænomenon* of the *Change* of *Color* producible in ſolutions of *Copper* by the operation of the Air; I ſhall now add what further *Phænomena* my Memory or Notes ſupply me with, about the Subject of that and the like Experiments.

Experiment the Firſt.

We took filings of crude Copper, and put them into a Cryſtallin Glaſs of a Conical ſhape, into which we poured ſome ſtrong Spirit of Salt, (that was fitted for our peculiar purpoſe) to the heighth of about a fingers breadth above the Filings; and then cloſing the Veſſel with a Glaſs-ſtopple exquiſitly fitted to it, we ſuffer'd it to continue unmoved in a Window for ſome dayes, till the liquor had both obtained a high and darkiſh brown colour by the ſolution of ſome of the Copper, and loſt that colour again, growing clear like common water, (which is it ſelf a ſomewhat odd Phænomenon;) and then taking out the ſtopple, (without ſhaking the liquor) and thereby giving acceſs to the outward Air, we perceived, (as we had conjectur'd) that the upper ſurface of the liquor did in a few minutes re-acquire a darkiſh brown colour, which penetrating deeper and deeper, at the end of about a quarter of an hour the whole body of the liquor appear'd to be likewiſe tinged. The Conical Glaſs being again well ſtopt, the *Menſtruum* did again in very few daies let fall or otherwiſe loſe its tincture; which, the ſtopple being taken out, it re-gained as before. Nor were theſe two the only Tryals I made with the like ſucceſs for the main; but

after-

afterwards being desirous by a further Tryal to resolve a doubt I had, I kept the Glass yet longer in the same place with the same Filings and *Menstruum* in it for (if I mis-remember not) a moneth or two together; but observed not, that the liquor would any more grow clear.

Experiment the Second.

Having taken such a Glass, as is mention'd in *Experiment the first*, wherein the liquor was grown clearer than is usual, and had probably been so a good while before, (for the Vessel, having been hid by others which stood before it, had been for some weeks forgotten;) We took out the stopple and left it open for about half an hour, but did not perceive the liquor to have acquired any colour so much as at the top. Whether this proceeded from the long debarring of commerce with the fresh Air, or from some other cause, being unable to wait the event as long as would perhaps be requisite, I thought fit to try, Whether the Air had already had some operation upon the liquor, though it did not yet appear; and accordingly putting in the stopple, I left the Vessel closed for two or three hours, and at my return to visit it, I perceived, that it had acquired a faint colour tending to a *green*; wherefore taking out the stopple again, I open'd its Commerce with the outward Air, leaving the Glass unstopt for 20 or 24 hours, but found, that in all that time it had not re-gained its wonted dark colour, but was only arrived at a green, deep enough, but not true nor very transparent.

This Observation being made in the same Vessel that had been formerly employed, suggested to us an Enquiry, Whether the advanced time of the year, which was the middle of *October*, might not have an interest in the slow and imperfect success of this Tryal.

Experiment the Third.

Some strong Spirit of Salt having been kept upon Filings of Copper till the solution was come to be of a dark brown colour, about three spoonfuls of it by guess was put into a Receiver that might hold eight or ten times as much: Being kept *in vacuo* (if the time be rightly remember'd) about half a year, it retain'd its colour, but the Vessel being open'd and the External Air permitted a free access to it, the solution in about an hour was turn'd into a fine transparent green, though no Precipitation of any muddy substance appeared by any Sediment to be made.

Experiment the Fourth.

In one of that sort of Conical Glasses that has been already more than once describ'd, we had put upon some Filings of Copper a convenient quantity of our *Spirit of Salt*; and though we observ'd, that for a great while it would not part with its deep and somewhat muddy tincture; yet we left it in the window for many weeks longer, and at length, towards the latter end of *December*, we found it to have lost its tincture, so much that the liquor appear'd like common water. Upon which observation, though the time of the year were unpromising, I thought fit to try, whether the Air in that season would not have some, though perhaps but a slow, operation on the Saline Spirit, and accordingly taking out the Glass-stopple to give free access to the outward Air, we observ'd, that in some hours its operation on the liquor was scarce sensible, but within about 24 hours the *Menstruum* had acquired not just its former colour, but a somewhat faint and moderately transparent green: So that this tincted *Menstruum*, as it had been very slow in losing its colour, so it did but slowly and imperfectly re-acquire it.

I *Have not in the foregoing Experiments made mention of any Phænomena of them relating to the* Spring *of the* included Air, *because I do not remember, that they were such as invited me to draw any positive Conclusion from them, and my silence on this occasion may be the more allowable, because the way of further making such Observations may be sufficiently deduc'd from the insuing Tryals; in reciting of which I alter very little, and in some of them not at all, the expressions I find them register'd in, though more than once the* Phænomena *that relate to the Air's Elastic power be mingled in the same Experiment with the mention of its operations upon Colours.*

The Spring of the Air and its variations, by the wayes now known to many of the Curious, being things that manifestly appear to have a notable interest in divers Phænomena of Nature, whose Causes, *if not* themselves *also, were unknown to former Philosophers; it seem'd an Attempt, though not very promising, yet worth the making, to try whether the Spring of the Air, which may divers wayes, as by Heat, Compression, &c. be increas'd, may not by some other way than Cold and Dilatation be weaken'd: And having often found Menstruums that corrode Metals, so as to produce* bubbles *to invigorate the strength*

of the Spring of the Air included in the Veſſels, wherein the ſolution was made, I thought fit to try, whether in ſome metalline Diſſolutions, wherein I had obſerved that few or no *viſible* bubbles *at all were produced, the Spring of the neighbouring and included Air would not be debilitated; and in order to this were made the following Tryals.*

Experiment the Fifth.

[WE took ſome Filings of Copper, and putting them together with a *Mercurial gage* * in a Conical Glaſs fitted with an exactly ground ſtopple of the ſame matter, (which was Cryſtalline) we poured on the Filings as much rectified *Spirit* of *fermented Urin* made *per ſe*, as ſufficed to ſwim an inch or better above them; then carefully ſtopping the Glaſs, coming to look on it many hours after, we perceived that the Mercury in the ſeal'd leg was conſiderably depreſt, and gently drawing out the ſtopple to let in the outward Air, we perceived that acceſs to have a manifeſt effect upon the Mercury.]

* About ſuch Glaſſes ſee *Experiment the Seventeenth* in the Continuation of our New Phyſico-Mechanical Experiments.

But this will be better underſtood by the more Circumſtantial Experiment that inſues.

Experiment the Sixth.

[We took a Cryſtal Glaſs of an almoſt Conical ſhape, and capable of containing between five and ſix ounces of water, and furniſhed with a ſtopple of the ſame matter, that by grinding was exactly fitted to it. Into this we put a convenient quantity of clean Filings of good Copper, on which we poured as much ſtrong Spirit of (fermented, or rather) putrifi'd Urin, as ſerved to ſwim about an inch above the Copper, and having let down a Mercurial gage, ſo that it leaned upon the bottom and ſide of the Glaſs, we cloſed it very well with a ſtopple, and ſet it in a quiet and well enlighten'd place, having taken good notice at what mark the Quickſilver reſted in the open leg of the Gage. This done, we let the *Menſtruum* alone to work upon the Filings; which it did, as we foreſaw, ſomewhat ſlowly and very calmly *without* producing any noiſe or ſenſible bubbles, acquiring by degrees a very pleaſant blew colour, and the Glaſs being kept quiet in the ſame place for two or three daies longer, the liquor, as I conjectur'd would

See the reference in the foregoing Experiment.

would happen, began to lose of the intensness of its colour, which by degrees grew fainter and fainter, till at the end of three or four daies the liquor was grown very pale, and left me little doubt but that, if I would have staid some daies longer, it would have lost the remaining Eye of blew, and have lookt almost like common water. But being unwilling to tarry so long, I took out the stopple, that the Air *without* the Glass might have access to that *within*; and leaving the Vial in the same place and posture, my expectation was somewhat answer'd by finding, that within four or five minutes, if not less, the upper part of the liquor, that was contiguous to the Air, had acquired a fine blew colour, which descending deeper and deeper, before the end of the tenth minute had diffused it self, but somewhat weaken'd, through the liquor, whose colour was suffer'd to deepen for a while longer; so that in less than a quarter of an hour from the first unstopping of the Vial, the liquor was grown to be throughout of a rich Ceruleous colour, which grew almost too opacous within a few minutes longer: When carefully closing the Vial again with the same stopple as before, we set it aside in the same place, where, the included Air being denied all Commerce with the External, the liquor began again within two or three daies to lose of its colour; and, to be short, afforded me the opportunity of making a *second* Experiment, much like the former. And the like success I had, for the main, in a Tryal or two made in another Glass with another portion of the same Spirit of Urin, put upon the Filings of Copper; so that the Experiment was, in all, made divers times, as well when I was not, as when I was alone: And particularly, once to be sure that the *diurnal* Air as such had not any great interest in the *Phænomenon*; I made the Tryal successfully about Nine a clock at night in the presence of so well-known a Witness as the Learned Secretary of the *Royal Society*.

One Circumstance I forgot to take notice of, which was, that in most of these Experiments I forbore to shake the Glass, lest it shou'd be suspected, that the Agitation of the liquor might have raised some little fine powder that might have been supposed to have been precipitated out of the tincture, and, being thus mingled with the liquor again, restore it to its former colour; but in truth I did not perceive any such powder to be precipitated. And though, to obviate the objection, I forbore to shake the Vial;

yet

yet I juſtly ſuppoſed, that if, by the agitation of the liquor, more parts of it ſhould be quickly expoſed to the action of the Air, the Coloratiou would be haſten'd, which upon tryal appear'd to be true.]

Experiment the Seventh.

[Experience having made me think it likely, that ſtrong *Spirit* of *Sal Armoniac*, made without Quick-lime, would operate more nimbly and more powerfully on that metal than our Spirit of Urin had done; we took ſuch a Conical Glaſs, as has been lately deſcribed, and covering the bottom of it with a convenient quantity of Filings of good Copper, we poured on them as much ſtrong Spirit of *Sal Armoniac* as ſerved to ſwim about a fingers breadth above them; and, having let down ſuch a Mercurial Gage as is formerly mention'd, ſo that it leaned upon the bottom and ſide of the Glaſs, we cloſed it very well with a ſtopple and ſet it in a quiet and well enlighten'd place, having taken good notice at what mark the Quickſilver reſted in the open leg of the Gage: This done, we let the *Menſtruum* alone to work upon the Filings, which it did, as we foreſaw, ſomewhat ſlowly and very calmly, without producing any noiſe or ſenſible bubbles, acquiring by degrees a very pleaſant blew colour, and afforded us alſo the Phænomenon we chiefly lookt after; which was, that repairing from time to time to the window to ſee what paſt, we perceived, that for two or three daies together the Mercury in the ſeal'd leg of the *Gage* did, though very ſlowly, deſcend till it appear'd to be near a quarter of an inch lower than at firſt; and probably the depreſſion might have been greater, if ſome indiſcreet body or other had not, by tampering with the Glaſs, diſturbed the Experiment; whoſe event yet ſeemed ſufficiently to argue, that the Spring of the Air, contained in the cavity of the Glaſs, and communicating with that in the open leg of the Gage or Syphon, was weaken'd in compariſon of that in the cloſed leg, which by the Hermetic Seal on one ſide, and the Quickſilver on the other ſide, was kept from ſuch Communication.

And becauſe I thought, it might be ſuſpected, that the Phænomenon might be referrable to ſome Inequality in the preſſure of the Air, occaſioned by the greater operation of the heat of the day on the more impriſon'd Air of the Gage, than on that more immediately included in the cavity of the Vial; I was careful to obſerve

obſerve, whether the Depreſſion did not continue at differing times of the day, and found it to do ſo, as well at night as at noon, though at this laſt named time the Sun ſhined hot upon the place and Veſſels too.

This Experiment was made, in all, four or five times, though not alwaies with equal, yet ſtill with ſome, ſucceſs, the Mercury in the ſeal'd leg of the Gage being ſometimes more and ſometimes leſs, but alwaies manifeſtly depreſt; which Phænomenon was confirmed by the Obſervation we more than once made of the ſudden return of the Quickſilver to it former ſtation, upon the unſtopping of the Glaſs, to give free admiſſion to the outward Air.

Experiment the Eighth.

Conſidering, whilſt I was about theſe Tryals, that *Spirit* of *Vinegar*, though in working upon Coral and ſome other Bodies it not only produces ſtore of bubbles, but alſo, as I have elſewhere deliver'd *, a ſomewhat odd kind of Elaſtical Subſtance, yet being put upon *Minium* it was wont, in my Obſervation, to work calmly and without producing froath; I thought fit to make tryal, whether this calm and ſilent ſolution of *Minium* would be accompanied with a permanent change of the Airs Spring: The Event I find thus ſet down:

* To the bettet underſtanding of this, the enſuing Tryal may much conduce; and therefore is tranſcribed out of another paper, to which it properly belongs.

A Mercurial Gage having been put into a Conical Glaſs whoſe bottom was covered with beaten Coral, ſome Spirit of Vinegar was poured in, and then the Glaſs ſtopple, which was very well ground, cloſing the neck exactly, we obſerved, that upon the working of the Menſtruum on the Coral, ſtore of bubbles were for a good while produced, which ſucceſſively broke in the cavity of the Veſſel, and their acceſſion ſo conſtipated the Air, that they compreſt the Air impriſon'd in the cloſed leg of the Gage three marks or Diviſions, which I gueſſed to amount to about the third part of the extent it had before: But ſome hours after the Corroſion had ceaſed, the Compreſſion made by this newly generated Air grew manifeſtly fainter, and the impriſon'd Gage-Air drove down the Mercury again 'till 'twas depreſt within one diviſion of its firſt ſtation; and thereabouts, or little lower, continued five or ſix dayes; ſo that in this operation there ſeemed to have been a double Compreſſive Power exerciſed; the one *tranſient*, by the brisk agitation of Vapours or Exhalations, and the other *durable*, from the Aerial and Springy Particles, either produced or extricated by the action of the Spirit of Vinegar upon the Coral.

[A pretty quantity of *Spirit* of *Vinegar* being put upon *Minium* in a Conical Glaſs, furniſhed with a Glaſs ſtopple and a Mercurial Gage, continued divers dayes without any ſenſible Depreſſion of the Mercury in either leg, nor did any change appear in the

the *Gage*, upon the removal of the ſtopple, though 'twas evident by the great ſweetneſs acquired, that it had made a Solution of a great portion of the *Minium*.]

But to return to our Tryals upon Copper;

Experiment the Ninth.

[We took ſome Filings of Copper, and in a Vial capable of holding ſome two or three Ounces of Water, we poured on them ſtrong *Spirit* of *Sal Armoniac* made without Quicklime, till the liquor reached near an Inch above them. This was done about the twentieth of *Auguſt* on the *Friday* before Noon, and the following *Munday* preſently after Dinner it had acquired a deep Blew tincture, and loſt again ſo much of it, that 'twas pale almoſt like common water: Then to ſatisfie a *Virtuoſo*, I unſtopt the Vial, deſiring him to place his eye level with the ſurface of the liquor, which in a minute of an hour or leſs appeared, to his ſurprize and wonder, to have acquired a deep Blew tincture, that reached downwards to the thickneſs of the back of a knife, the whole liquor becoming of the like Colour in four or five minutes more, and the Glaſs being preſently ſtopt again, and left where 'twas before, appeared not at the end of nine daies to have loſt its tincture; though now and then within that time it ſeemed manifeſtly paler than when the Vial was ſtopt.]

NOne of the former Tryals with Spirit of Sal Armoniac having been made in an Hermetically ſealed Glaſs, it will not be amiſs both to diverſifie and to confirm our Experiments, by ſetting down the ſucceſs of one made in ſuch a Veſſel:

Experiment the Tenth.

[We took a round Vial holding about eight Ounces of water, and having put into it Filings of Copper and a Mercurial Gage, we poured on the Metal ſtrong Spirit of Sal Armoniac, till it reached to a good height in the Vial, which then being Hermetically ſealed up, was ſet by in a South-window, where it quickly ac-

quired a deep Blew tincture: There it stood about twelve daies, before that tincture, which decayed but slowly, did little by little grow so diluted that the liquor was pale and almost like water: During this stay of the Glass in the window, the Mercury in the open leg appeared to be impell'd up, and when after nine a clock at night, (which time I chose to try whether the Nocturnal Air, as Nocturnal, would have any thing to do with the Phænomenon,) the Hermetic Seal was broken off; immediately upon which there was produced a noise, and the Mercury in the shorter and closed leg was briskly impell'd up, by our guess, near three eights of an Inch, and though the Orifice at which the Air had access was scarce wide enough to admit a middle seized pea, yet within a minute and half the surface of the liquor being held between the Eye and the Candle, appeared to have acquired a very lovely and fair Colour, which reached downwards a quarter of an Inch; so that the Vial seemed to contain two very differing liquors swimming on one another, and the Coloration piercing deeper and deeper within five Minutes in all, the whole liquor had attained a rich Blew colour.]

With this Experiment I shall conclude this Paper: For, though I made several other Tryals, with the same design that I made the foregoing ones, as with Spirit of Niter, *and* Minium, Spirit of Vinegar *and* Copper; *yet a present want of time hinders me from troubling you with them, which I the rather forbear to do, because I fear, they would prove less satisfactory than those I have set down; which themselves must, to a less discerning eye than yours, appear very imperfect, notwithstanding that prolixity in reciting some of them; which I was obliged to by my not yet knowing, in such odd attempts, what Circumstances might safely be omitted. But such as they are I send them you, who by your diffused Correspondency have great opportunity to get them made, if you think them worth it, by Curious persons in several Countries, various manners, and differing seasons of the Year: And, however the things I send you be but trifles, yet their Novelty may perhaps excite the Industry of others, and give rise to further Inquiries.*

Some

Some Experiments made in the Air-pump upon Plants, *together with a way of taking exhauſted Receivers away from off the ſaid Engin: Tryed by the ſame Perſons mention'd in* Numb. 119. *viz. Monſieur* Hugens *and M.* Papin.

I Took one day a ſmall Recipient ſhaped like that, deſcribed formerly *, and inſtead of an Iron wire, I paſſed into the little hole a ſprig of a known Plant, which was *Baulme*, ſo as that the Top of the plant was within the Recipient, and the Roots without. Then I cloſed the reſt of the hole with cement, that ſo I might keep it void a good while: But becauſe I was not willing, that it ſhould embaraſs the Engin, 'twas neceſſary to find a means of taking it away when exhauſted. For that purpoſe I uſed the following method, which is very ſure and very commodious, and which hath ſerved me for many other Experiments hereafter to be related.

* See Numb. 119. p. 443.

The method was this: I cauſed the edges of the wide Orifice of my Recipient to be well ground, ſo as that being applyed, it every where touched the Glaſs-plate, which had alſo been very ſmoothly ground to ſerve for a cover to the ſame; and I ſpread a piece of Lambskin wetted over the ſaid plate, and having thus applyed it to the Engin, I put my Recipient over it: But in one place there was a Hail-ſhot of lead, which kept the Receiver from being exactly applied to its cover, that ſo the Air might more freely get out. And having afterwards whelmed another great Receiver over all, I cauſed the Pump to be plyed. All being well evacuated, I ſhook the Engin ſo as that the little Receiver fell off from the Hail-ſhot, and ſtood every where cloſe to the skin, expanded over the cover of the Glaſs-plate. Then I had no more to do but to ſuffer the Air to re-enter into the great Receiver, and this Air preſſing upon the little one, kept it ſo cloſely faſten'd to its cover, that it was impoſſible for me to ſever them. And I am aſſured, that the Air enters not into the ſmall Receiver, when 'tis thus applyed upon the skin; for I have often put *Gages* in them, which alwaies kept at the ſame height, although the Air was permitted to repaſs into the great Receiver. You might alſo let alone the putting under of the Hail-ſhot to keep up the little Re-

cipient, because the Air by its Spring would lift it up sufficiently; but then the *vacuum* would not be so perfectly made.

When I had thus taken away my little emptied Receiver, with the Plant, half shut up therein; I put the whole into a great Glass filled with water, the Root being downwards; and I saw, that there were formed little water-drops upon the leaves that were in *vacuo*. I left it ten daies in this condition, and during that time there was entred about two spoonfuls of water in the Receiver, and in all appearance this water had pressed through the Plant. Yet there appear'd no more any drops upon the leaves; but that might very well come from the grosser excrementitious matter that is in the water, which had stopp'd the Conduits.

After this, to know whether any Air had been form'd there, I replaced the Receiver upon the Engin, and having whelmed a bigger over it, I saw there was but very little Air form'd in the small one, because the great Recipient was almost all empty before the Air included in the little one could lift it up. Yet at last it did raise it, and I enclined the Engin, to the end that the little Receiver might not be applied to its cover when I should let the Air re-enter; and after this manner both the Recipients were filled in the same time. Then I looked upon the leaves of the Plant. They were not withered, though they were not grown; only the leaves had in the middle a little changed their colour, and had a smell somewhat sowrish; but the next morning the plant was quite spoiled. We may believe that the pressure of the Air had made the water enter into this plant with so great a violence, that thereby it had, as 'twere, mortified the parts, especially in the middle where the leaves were most tender; but this water still kept the leaves extended, and so they withered not; but, when the Air came to act upon them, the parts of the Plant that had so much suffer'd were soon corrupted by it. For 'tis very probable, as well by this Experiment, as by others hereafter to be mention'd, that the Air is a Dissolvent which corrupteth Bodies *.

* See the Micrography Obs. 16.

This being done, I made the Experiment the other way, that is, with the Leaves *in the Air*, and the Roots in a bottle of water that was in *vacuo*; and immediately I saw Air-bubbles issuing out at the end of the tail in *vacuo*. After

ter this, I put water upon the leaves, to see whether this Air came from thence, and I saw indeed soon after, that these bubbles began to cease; and having taken away the water wherein the leaves were, I saw that the bubbles began again to issue out at the tail as before: And I saw them *still* come out 24 hours after, but in little quantity; and at length they quite ceased. During these 24 hours the Roots did lengthen about four lines, that is, one third of an Inch; which is a little less than they ordinarily do in the Air.

I kept the Plant in this condition for four daies upon the Engin, and took care from time to time to draw out the Air that entred into it by the leaves; and then it began to wither, and the Roots shot no more.

Another time I put two twigs of *Baulme*, each into a Vial full of water, and at the end of five daies, when I saw manifestly that they both shot Roots, I included in the *vacuum* that of the two which had the longest roots, without taking it out of its Vial. At the end of three daies, observing that it was wither'd in *vacuo*, I took it out, and changed the Vials of the twiggs, to see, whether that which had remain'd *in the Air*, and did thrive very well in common water, would also thrive in water freed of Air; and whether that which was wither'd in *vacuo*, would revive in the common water and in Air. *Four* days after I found the twigg that had been in *vacuo* quite spoiled, and the other still verdant, but not thriving; and I observ'd, that it did not begin to shoot in the water freed of Air till ten daies after it had been put in.

This Experiment drew another after it, to know, whether the water purged of Air were less fit than common water to make plants vegetate. For this end I took two Vials full, the one of water purged, the other of common water, and having put a twigg of *Baulme* in each, I left them both in the Air. I found, that the twigg in the common watrer shot at the end of six daies, and in water purged shot this time neither but ten daies after it had been put in.

I repeated this Experiment once more, and I was much surprized to see, that the twigg in the water freed of Air begun this time to shoot the third day, and the other in the common water, still the sixth day. But this was remarkable herein, that the twigg in the

the water purged ſhot not more but one root which grew very long, and on the ninth day only it began a little to ſhoot another, which lengthen'd but one line in two daies, whereas the twigg in the common water had then nine or ten roots, which were all very long, having alwaies lengthen'd five lines or more in a day.

Although this Experiment appear'd at firſt contrary to the precedent, yet it ſtill confirmed the firſt thought, to wit, that the Air which is mixed in common water ſerves for vegetation, conſidering the little root which the twigg ſhot in the water cleanſed of Air. Meantime I do not believe, it will be eaſie to know the particular reaſon, which made the firſt root ſhoot ſo ſoon.

After this, I made ſome Experiments upon *harder* Plants. One day I put a green piece of *Sallow*-wood, part in the Air and part in *vacuo*, after the manner above deſcribed. I put into water that part which was in the Air, and the water preſently began to mount and to paſs through the middle of the wood, and unceſſantly form'd bubbles in the Receiver. Theſe bubbles continued thus for the ſpace of 24 hours; and certainly it was the water, which paſſing thorow the wood was in part changed into Air. For, I made the ſame Experiment with a piece of *Buffe*, and the water mounted alſo and paſſed through it, but it formed no bubbles. Meantime, if there be *Valves* in wood, they muſt needs be unable to reſiſt the preſſure of the Air; for I have noted in *Sallow*, as well as in *Elm*, that the water paſſes through them with the ſame facility what end ſoever you put in *vacuo*.

One day alſo I put the upper end of a little *Elm*-branch in the *vacuum*, and the lower end in the Air. This lower end I drenched in water, as I had done the Roots of *Baulme* in the firſt of theſe Experiments: But it was a whole hour before there appear'd any drop of water upon the *Elm*-leaves in *vacuo*, whereas upon the *Baulme*-leaves the drops appear'd preſently. The cauſe of which may be the hardneſs of *Elm*-wood. But I know not, why water paſſing through *wood* forms bubbles, and in paſſing through *leaves* forms nothing but drops.

I made alſo the Experiment the other way, that is, the Leaves in the water without the Recipient, and the lower end of the branch in *vacuo*, and I ſaw, that there paſſed nothing for two hours time; in-

insomuch that I cut a little of the upper end of the branch which was very tender, and then indeed I saw a little moisture appear at the end that was in *vacuo*, but that enough only to form one drop; and there appear'd no bubble of Air. Then I cut the branch yet a little lower, and then there was form'd one drop of water at the end that was in *vacuo*, but it fell not. And having cut the branch yet a little more, the drop of water fell down in *vacuo*. This shews, that they were not the *valves* of the plant that hindred the water from passing whilst the branch was entire; but rather that it was the great tenderness of the leaves, suffering themselves to be compress'd by the pressure of the Air, and that so the water could not insinuate it self between their parts.

An Account of some Books:

I. *Francisci Willughbeii de Middleton Armigeri, è* Reg. Societate, *ORNITHOLOGIÆ Libri tres; in quibus* Aves *omnes hactenus cognitæ, in methodum naturis suis convenientem redactæ, accuratè describuntur;* Descriptiones *Iconibus elegantissimis & Vivarum Avium simillimis, æri incisis, illustrantur: Totum opus recognovit, digessit, supplevit* Joh. Rajus, *pariter ê* Soc. R. *Sumptus in Chalcographos fecit Illustriss. D. EMMA WILLUGHBY, vidua.* Londini, *Impensis* Joh. Martyn, *Typographi* Soc. Regiæ, *ad insigne Campanæ in Cœmeterio* D. Pauli, 1676, *in fol.*

AS the person, that hath review'd, methodized and supplied this Work, Mr. *John Ray*, hath given to the worthy and learned Author thereof his just Elogy in the Preface; so we cannot but very thankfully acknowledge not only the Industry, Care and Accuracy of the said person in digesting and perfecting it, but also the Bounty of that Excellent Lady, the Authors Relict Widow, enriching the same with so vast a Number of Elegant and Costly Figures; whereby She hath indeed immortalised Herself as well as her Deserving Consort, and manifested to the World, that in a time when many stain their lives by unworthy pleasures, she knew how to adorn hers by the exercise of Ingenuity and Vertue: In the doing of which, as she hath put a lustre upon herself, that makes her outshine many of her Sex; so she hath raised in Us very great hopes, that she will continue the same nobleness in the publication of the rest of the *History of Animals*, mention'd in the *Preface*.

Having

Having paid this ſmall Tribute to the merit of this Generous Lady, I ſhall now proceed to take notice of the Work it ſelf; and *Firſt*, of the deſign thereof, which is not to give Pandects of Birds, or to collect indiſcriminately what hath been already publiſh'd, whether true or falſe, on this ſubject; but to illuſtrate and put into good order the Hiſtory of Birds, *partly* by deſcribing the Birds themſelves upon Ocular inſpection, *partly* by borrowing the deſcription of thoſe, of which the Author and Publiſher themſelves could not get a ſight, from the beſt Writers upon this Argument: Endeavouring principally, to deſcribe and difference all the known *ſpecies* of Birds, and to reduce them to their ſeveral *claſſes*, and thereby to take away that confuſion and obſcurity, which this Hiſtory hath hitherto laboured under.

Secondly, The Work it ſelf is divided into three Books; whereof the *firſt* treats of Birds in general; the *ſecond*, of Land-fowl; and the *third*, of Water-fowl.

Concerning the *firſt*, in it are deſcribed the principal both *Outward* and *Inward* Parts of Birds, ſuch as are either peculiar to them, or ſhew a peculiar ſtructure and uſe in them. In the *external* parts, the Author obſerves, among other particulars, that the *Pectoral* Muſcles in Birds are the thickeſt and ſtrongeſt of all, ſerving for the motion of their Wings that require great ſtrength; whereas in Man, the *Crural* Muſcles are ſtronger than thoſe of his Arms; whence, if *Flying* were either poſſible or fit for Man, his legs, furniſh't with a *ſuccedaneum* to wings for compreſſing and beating the Air, would ſerve him better for that purpoſe, than his Arms. In the *Internal* parts, he notes, among many other things, the conſiderable difference there is between the *Brain* of Birds and that of Man and Quadrupeds; adapted in Birds more for the exerciſe of the Locomotive faculty, than for Imagination and Memory.

Diſcourſing in this Part of the *Generation* of Birds, he judgeth it highly probable, that their Females have in them, from the time of their being firſt born, all the Eggs or the Primordials of Eggs, that they ſhall lay as long as they live: which he thinks to be true of Human and all other Females; making the *Incubation* of the Eggs of Fowl to be equivalent to the *Geſtation* or Bearing of other Animals; and calling the *Ovum* an *Uterus expoſitus*, foraſmuch as it miniſters aliment to the *fœtus* of thoſe that are commonly call'd Oviparous, in like manner as the Womb doth in the Viviparous.

Treating

Treating of the *Age* of Birds, and of some of their observable proprieties and qualities, he notes, *that* they live long; *that* their structure somewhat resembles the built of a Ship; *that* some of them, as *Partridges* and *Pigeons*, lead a Conjugal life, and that of those Birds that do so, there are more Males than Females, as among those where one Male is sufficient for many Females, there are more Females than Males; *that* some of them are very ingenious, and imitate the Human voice, as *Parrots*, *Thrushes*, *Blackbirds*, *Jackdaws*, *Starlings*, *Nightingales*, of which last, and of *Parrots*, he relates very extraordinary things, *p.*79,161.

To all which he subjoyns some *Quære's* of particulars, further to be satisfied; and then takes notice of some Isles, Rocks and Cliffs about *England*, notable for great multitudes of Birds breeding therein.

He concludes this *first* Book with an accurate *Division* of Birds, and with a *Catalogue* both of such as do constantly abide in *England*, and such as come at one season of the year, and go away in another.

In the *second* Book, treating of *Land-fowl*, he considers *first* those that have *Hooked* Beaks and Claws; and *secondly* those that have them more *Straight*. The *former* are either *Carnivorous*, and of these, some intent upon their prey by day, others by night; or *Frugivorous*. Concerning the *Carnivorous* or Rapacious, he takes notice: 1. That, though *Aristotle* gives out, they fly solitary, when he saith, γαμψωνύχων οὐδὲν ἀγελαῖον; yet that holds not in all, seeing that *Vulturs* have been observ'd to fly in troops, fifty or sixty together. 2. That the Females of the Ravenous Birds are bigger, stronger, and of greater courage than the Males; Nature seeming to have been so provident as to furnish those Females with such advantages, upon the account that they must procure food not only for themselves but also for their young ones. 3. That whereas all other Birds make their own nests, if need be, and sit upon and hatch their own Eggs, the *Cuckow* makes use of other nests, deserts her Eggs, and leaves them to be hatched by other Birds. Of the *Frugivorous* he observes amongst other particulars: That, as *Quails* eat Hellebore, and *Starlings* Hemlock, without any harm to themselves; so *Parrots* not only eat innoxiously the seed of *Carthamus* or *bastard Saffron*, but also grow fat thereby; which yet is a Purgative to Man. To which he adds relations out

of *Clusius* of some uncommon *Parrots*, so docile, as to learn whatever they are taught by those that instruct them.

Amongst those that have *Straight* Beaks and Claws, he observes: *That* the *Cassaware* (as well as the *Pellican*) is without a tongue; swallowing not only bits of Iron as the *Ostriches*, but also red-hot Coals; yet not digesting the Iron, but voiding it whole, as the *Ostrich* also doth: That *Capons* may be made to keep, feed, call together, and cover under their wings young Chickens, just as Hens will do; adding the method for accustoming them to it: That the Custom of making use of *Pigeons* for carrying of Letters is as ancient as the Seige of *Mutina* or *Modena*, in the time of *Hirtius* and *Brutus*: That *Pigeons-flesh* is good for Paralytical persons: That *Swallows*, distilled with some *Castoreum*, Pyony roots, and White-wine, are an approv'd remedy against the Epilepsy, &c. And so much of the *second Book*.

The *Third*, treating of *Water-fowl*, is subdivided into three parts: The *first* contains those Birds, that live *near* water, but not *in* or *upon* it. The *second*, those that live much *in* the water, being *Fissipeds* (having their toes sever'd,) and *long-shanked*, and of the amphibious kind, partaking of the nature of both those that live *near* water and swim *in* it. The *third*, those that are *Palmipeds*, whose toes are joyned together with a membrane. Of those that live *near* wet places, some again live upon *Fish*, or *Slime* (out of which they suck something that is oleose, and from thence yield a delicate flesh, as *Wood-cocks*, *Snipes*, *Curlews*, &c.) or on *Insects*. Of the *Piscivorous*, the *Stork* is by our Author noted to be seen in *England* only when he is driven thither by high winds or other accidents. The like is observ'd by *Faber* the *Lyncean* Academist, of *Italy*: Which may be somewhat wondred at, since 'tis certain, that *Storks* do, before the approach of Winter, pass away out of *Germany*, (where they summer in great numbers,) into warmer places, and yet not into *Italy*, which is contiguous to *Germany*, and much warmer than it. The *Penguin*, though it likewise lives on Fish, yet is said not to taste of it, as other Fish-eaters do: Besides, the same is observ'd to digg deep holes, like Conies, on the Sea-shore, and to make the whole ground thereabout so hollow, that the Seamen walking over it do often fall in knee-deep. The *Anser Bassanus*, the *Soland Goose*, breeding in the Isle of *Bassa*, near *Edinburgh*, lays and hatches no more

more than one Egg at a time. They come thither in Spring, and fly away in Autumn, but whither, is not known. The *Colymbus minor*, or *Didapper*, has such a structure of parts, that he moves much more easily under water than on its surface, or aloft: He raises himself from the water with great difficulty; but when he is got up into the Air, he can then continue his flight long enough. The *Swan* is very long-lived, and takes almost two moneths time in hatching her Eggs: And the wild kind of Swans have their wind-pipes passing into the *Sternum*, and there reflecting or turning back; the Use of which is thought to be, that when this Bird sometimes for near half an hour with his whole head and neck dives to the bottom for food, turning up his feet on high, there may then from that part of his wind-pipe, which is included in the said sheath of the breast, as from a repository, be furnish't Air sufficient for so long a time of diving. The *Bernacle* or *Clakis*, of the *Goose-kind*, is not bred out of the rotten boards of ships, nor of fruit fallen from Trees into the Sea, nor of Sea-shells; there being no such thing as æquivocal generation in Animals; and those *Bernacles* being known by the experience of credible Observers to lay and hatch Eggs as other Birds do.

But if we should take notice here of all the curious and remarkable Observations, recorded in this excellent Work, we should then be obliged to fill up many of these Tracts with them alone. We must therefore, having only given the Reader a taste of them, refer him to the Author himself, who will doubtless satisfie his expectation and curiosity in innumerable particulars: Amongst them of the extraordinary melodious singing of some Birds; the annual Moulting of all Birds; the Medicins to be prepared out of some of them, and their very Excrements; the artificial Nests of many of them; the tasting of the *Indian Raven* of Nutmegs, on which he feeds; &c.

II. *The Comparative ANATOMY of the TRUNKS of Plants; together with an Account of their VEGETATION grounded thereupon, by* Nehemiah Grew *M. D. and Fellow of the* Royal Society: *Printed by the Assigns of* John Martyn *Printer to the said Society, for* Walter Kittilby, *in* 8°.

AS there hath been a very happy Concurrence of these two eminently Learned persons, Signor *Malpighi*, and our present Author Dr. *Grew*, both Fellows of the *R. Society*, in making and exhibiting their ingenious and accurate Beginnings * concerning the *Anatome of Plants*, and thereby giving a New Country of Philosophy; so they have both been very industrious in pursuing this subject, in many things confirming one anothers Observations, and in some few ones supplying one anothers defects; the particulars of which we shall rather leave to the sagacious and impartial Reader to find himself in perusing and comparing both their Books, than make a stay here to specifie them.

* See the *second* of the Letters subjoined to Signor *Malpighi*'s Book *de Anatome Plantarum*, printed by *John Martyn*, 1675. in fol.

Instead thereof, we shall present him *first*, with some generals of this Philosophical Mapp, and *then*, with the particulars represented therein.

In *general*, it is noted by our Author, that it will here appear, *that* there are those things which are little less wonderful within a Plant than within an Animal; *that* a Plant, like an Animal, hath Organical parts, some whereof may be called its Bowels; *that* every Plant hath Bowels of divers kinds, containing divers Liquors; *that* even a Plant lives partly upon Air, for the reception whereof it hath peculiar Organs. Again, *that* all the said Organs, Bowels, or other parts are as artificially made, and as punctually for place and number composed together as all the Mathematical Lines of a Flower or Face; *that* the Staple of the Stuff is so exquisitely fine, that no Silkworm is able to draw so small a thred; *that* by all these means the Ascent of the Sap, the Distribution of the Air, the Confection of several sorts of Liquors, as *Lymphas*, *Milks*, *Oyls*, *Balsoms*, with other acts of Vegetation, are all contrived and brought about in a Mechanical way.

In *particular*, we find in the *first* of the *two* Parts of this Book;

1. A Deſcription of *ſix* ſeveral *Trunks* of Plants, as they appear to the *naked eye*, viz. of *Borage*, *Dandelyon*, *Colewort*, *Holy-oak*, *wild Cucumer*, *Endive*.

2. An accurate Deſcription of ſeveral Trunks and parts of Trunks, as they appear through a good *Microſcope*; which parts are, the *Bark*, the *Wood*, and the *Pith*. Of the *Bark* he deſcribes the *Skin*, the *Parenchyma*, and the *Veſſels*; the laſt of which he finds in the Bark to be alwaies and only *Sap-veſſels*; which yet are ſpecificated and diſtinguiſh't one from another, both in the ſame Plant, and in the ſeveral *Species*'s of Plants, by many properties, which are not accidental, but ſuch as ſhew the conſtant and univerſal deſign of Nature: Which he ſhews by the deſcription of the *Barks* of ſeveral Trunks, viz. *Holly*, *Hazel*, *Barbery*, *Apple*, *Pear*, *Plum*, *Elm*, *Aſh*, *Walnut*, *Fig*, *Pine*, *Oak*, *Sumach*, *Wormwood*. In ſome of which he finds Sap-veſſels to be only *Lymphæducts*; in others, *Lymphæducts* and *Lactiferous*; in others, *Lymphæducts* and *Reſiniferous*; laſtly, in ſome, *two* kinds of *Lymphæducts*, and *one* of a ſort of *Reſinous*. To which he ſubjoyns an Anſwer to that curious Queſtion, viz. if the *Stringy parts* of the Bark are made up of *Tubes*, what theſe Tubes themſelves are made up of? And that done, aſſerts the Analogy betwixt the *Veſſels* of an *Animal* and a *Plant*.

3. Having thus deſcribed the *Bark*, he proceeds to the *Woody part*; and here, in the ſeveral Trunks aforeſaid, he conſiders their two general parts, namely the *Parenchymous* part or *Inſertions*, and the *Veſſels*: The *Inſertions* much diverſified according to the ſeveral *Species* of Plants, for number, poſition and texture: The *Veſſels* have likewiſe much variety, yet are of two general kinds, namely, *Sap-veſſels* and *Air-veſſels*, whereas 'tis proper to the *Bark*, (as was intimated above) to have only *Sap-veſſels*. Of both theſe kinds of Veſſels he notes the variety, as to number, ſituation, and ſize; theſe affections being in no two *ſpecies* of Plants the ſame.

4. Laſtly, he deſcribes the *Pith*, firſt in general, and proves it to be, as to its ſubſtance, the ſame with the *parenchyma* in the Bark, and the *Inſertions* in the Wood: And then, he obſerves both the variety of its *ſize*, being not the ſame in any two branches, repreſented by him; and its being compounded of two parts, a *Parenchyma* and *Sap-veſſels*: The Parenchyma made up of *Bladders*, of very

different

different sizes and shapes in different Plants, and being of such a texture, that the sides of the greater bladders are compos'd of lesser; in the same manner as the *Sap-vessels* are but greater *fibers* made up of lesser.

To clear the better all he hath discoursed of the structure of a Plant, he resembles the whole *Body* of it to a piece of fine *Bone-lace*, at such time as 'tis wrought upon the Cushion. For, *saith he*, all the *Parenchymous* parts, as the Pith, Insertions, and Parenchyma of the Bark, are nothing else but *Lace-work*; the *Fibers* of the Pith running horizontally, as do the *threds* in the Lace, and bounding the several *Bladders* of the Pith and Bark, as the *threds* do the several holes of the Lace; and making up the *Insertions* without Bladders, or with very small ones, as the same *threds* likewise do the *close* parts of the Lace; which they call the *cloath-work*: And lastly, the *Vessels*, standing *perpendicularly*, run cross to the *horizontal* fibers; even as in the Lace the *Pins* do the threds. And this he makes to be the true texture of a Plant, and the general composure, not only of a *Branch*, but of all the other parts, from the seed to the seed.

To proceed to the *second* part of this Book, which gives an Account of the *Vegetation* of Trunks, grounded upon the foregoing Anatomy, and shewing the *Use* that may be made of the same in order to explicate the manner of *Vegetation*; the chief Heads, to which this whole matter is reduced, are these seven; *viz.*

1. The *Motion and Course of the SAP*; where he observes *two* kinds of Bleeding in the Plants; gives the causes of both; together with the cause of the Sap's Ascent.

2. The *motion of the* AIR; that it first enters the Plant by the Trunk, but chiefly by the Root, and is thence in a peculiar manner distributed throughout the whole Plant. Where he notes the use of the *Insertions* herein, and compares this use with that of the Membranous parts of the Lungs.

3. The *Structure of the* PARTS; where he explains the Union of the *Bark* to the *Body* of the Tree, with the cause of it: Considers the various Surface and Falling off of the Bark; the lessening of the *Pith* in the Elder branches; the ruptures of the Pith, and for what ends made; further, how the *Air-vessels* come to be less in the *Trunk* of the same Plant than in the *Root*; and those of the first year usually much less than those of the years following;

as

as alſo, how the *Air-veſſels* come to be formed alwaies late in the year.

4. The *Generation of* LIQUORS, depending upon the Structure and Formation of the Parts: Where he ſhews, that the concurrence of *two* ſpecifically diſtinct Liquors is as neceſſary to *Nutrition* in *Plants* as in *Animals*; and that the *Veſſels* are the chief *Viſcera* of a Plant; the *Viſcera* of an Animal being but *Veſſels* conglomerated, and the *Veſſels* of a Plant, but *Viſcera* drawn out at length. To which he adds a particular explication, how a *Winy* Sap is made, how a Reſinous, Oily and Milky; likewiſe, how the liquors of Plants come to be white; what is a *Roſin* properly ſo called; what a *Gum*; what a *Mucilage*.

5. The *Figuration of* TRUNKS; where he renders the cauſe of a Shrub, a tall Tree, a ſlender, and a thick Tree; as alſo of the roundneſs or angularneſs of a Tree.

5. The *Motions of* TRUNKS: where occurrs the cauſe of their Aſcent, and Deſcent into the ground; their Horizontal and Spiral motion; and whence *Solar* and *Lunar* Plants are diſtinguiſhed; ſome winding together with the *Sun* in its *Diurnal* motion, by South from Eaſt to Weſt; and others with the *Moon* in its *Monthly* motion, from Weſt to Eaſt.

7. The *nature of Trunks as variouſly fitted for* MECHANICAL USE: where he ſhows, whence woods are ſoft, whence faſt, hard, cleveſome, tough, or durable; why the Heart of Timber moſt durable; and why ſome Trees have Heart, and not others: Likewiſe, whence the toughneſs of Flax; and what ſorts of Plants ſerve for the beſt Tow: Giving laſtly an account, How all proſperous *Conjunctions* in Graffing may be known, and what is the chief Uſe of Graffing, *viz.* to accelerate the growth of good fruit.

III. *The* ROYAL ALMANACK, *&c. by* N. Stevenson, *one of his Majesties Gunners.*

AS I was exceeding glad, to see this ingenious and truly useful Almanack begun to be publish't the last year; so I could not but give notice to the world of its continuation: Being chiefly a Diary of the true Places of the Sun, Moon, and the other Planets, their Rising, Southing, and Setting; High water at *London-bridge*, with Rules to serve other places after the *New Theory* of Tides, and Directions of Sir *Jonas Moor*: To which are added the *Eclipses*, Tables of the Suns Rising, Moons Southing, Moons Rising and Setting; as also a Table of the *Suns* Right Ascension in Time for every Day at Noon, and of *Thirty one* of the most notable *Fixed Stars*: With the Moon and other the Planets Appulses to the Fixed Stars, for the Meridian of *London*, A. 1676. And lastly, instead of giving the impertinent guesses of the Weather hap-hazard, the Author gives notice of that useful Instrument the *Baroscope*, telling the changes of weather before-hand, even to admiration. All done with great pains and accurateness, according to the Rules of Art, for his Majesties Use, and at his Command, by *N. Stevenson*, one of his Majesties Gunners. Printed in *London* for the Company of Stationers, 1676. in 12°.

Note.

The Reader is desired to compare Mr. *Boyle*'s Physico-Mechan. Experiments touching the *Air*, Exp. the 22*th*, p. 176. ff. with pag. 468. lin. 7. of this Tract.

Errata left uncorrected in *Numb.* 119.

Pag. 462. l 31. r. *Bounds* for *Hounds*. p. 463. l. 15. r. *Wild boar*. ibid. l. 44. r. *each such charming*.

London, Printed for *John Martyn* Printer to the *R. Society*, 1675.

PHILOSOPHICAL TRANSACTIONS.

January 24. $167\frac{5}{6}$.

The CONTENTS.

A Continuation of the Experiments made in the Air-pump by Monsieur Hugens *and M.* Papin *at* Paris; *which are about the* Preservation of Bodies. *A Letter of Mr.* Flamsteed *to Sir* Jonas Moor, *containing his Observation of the late* Lunar Eclipse *on* Decemb. 21. *Mr.* Franc. Linus *his Letter to the Publisher, being a Reply to a Letter formerly printed by way of Answer to another of the said Mr.* Linus, *which relates to the* Newtonian *Theory of Light and Colours. Mr.* Newtons *Considerations in two Letters on the said Reply, together with further Directions how to make the Experiments controverted aright. An Accompt of some Books:* I. *PHARMACEUTICE RATIONALIS, sive Diatriba de Medicamentorum Operationibus in Humano corpore, Pars Secunda; Auth.* Th. Willis *M. D. &c.* II. *COLLEGIUM EXPERIMENTALE sive CURIOSUM, in quo primaria hujus Seculi Inventa & Experimenta Physico-Mathematica spectanda exhibuit & ad causas suas naturales demonstrativâ methodo reduxit* Joh. Christoph Sturmius, *P. P.* Norimbergæ. III. *ENGLANDS IMPROVEMENT, in two parts, by* Roger Coke. IV. *The Colledge of Physitians Vindicated, and the True State of PHYSICK in this Nation faithfully represented by* Charles Goodall, *M. D.*

A Continuation of the Experiments made by Monſieur Hugens, *and M.* Papin, *in the Air Pump; which are about the* Preſervation of Bodies *.

* Compare Mr. *Boyles* New Experiments about the *Preſervation of Bodies* in *Vacuo Boyliano*, printed, together with other Tracts, *A.*1674.

TO know, whether the *Vacuum* would be of uſe to the *Preſervation of Bodies*, I took an Apple, and included it with ſuch a *Cover*, as is deſcribed formerly in our Method of taking away an exhauſted Recipient from off the Engin. The Apple I choſe, had a little ſpeck of rottenneſs, and I did purpoſely include ſome water in the ſame Recipient, thereby to promote the corruption in caſe any ſhould come to paſs. But I have not found that any change happened to this Apple ſince the third of *April*, 1673. which was the day on which I included it *.

* Theſe Experiments were printed at *Paris* in French, in the year 1674.

The ſeventh of *June* I included in a Receiver two Noſegays of Roſes, one ſuſpended at the top, the other having its tail in a little Veſſel full of water. I alſo put in the ſame Receiver a Gage four Inches long, to know whether any Air would be there produced. Two days after I found my Roſes a little wither'd, and the water already riſen to eight or ten lines, near the top of my Gage; and after that, the changes of theſe Flowers became ſtill leſs, ſo that at this preſent time they are not much more wither'd, and the water of the Gage is by three or four lines near the top. The Roſes which lye dipt in the water are as much wither'd as the others, and as ſoon. I ſhall keep them in this condition as long as I can. Other Roſes which I had included at the ſame time, but *with* Air, grew mouldy in leſs than eight days.

At another time I included one ſingle *Roſe-button* in a very little Glaſs, to learn, whether it would keep its Scent. At the end of fifteen days it look'd a little leſs freſh, but was not at all wither'd; and having taken it out, I found, it had ſtill its good ſmell; but after that, it loſt all both colour and ſmell in leſs than two hours. I muſt alſo add, that its leaves did not appear moiſt in the *vacuum*, but they looked all moiſt as ſoon as they were in the Air. Which ſhews, that the parts of the leaves had acted as Springs, like as Spunges do, and that the weight of the Air coming to preſs upon them,

did

did expreſs the humidity which had inſinuated it ſelf between the parts thus expanded.

I did alſo include ſome *Gilliflowers*, which changed but very little; only they looked as if they had been dipped in water.

Having included ſome *Strawberries*, at the end of two days they look'd leſs freſh; but after that, ſeeing they changed no more, I took them out of the *vacuum*, after they had been there fifteen days. They had ſtill the ſmell and taſte of Strawberries; but they had alſo contracted a very ungrateful taſte of the cement which I then imployed to cloſe them up with.

At another time, I put up ſome *Strawberries* without cement, making uſe of a skin after the manner deſcribed formerly, and I then obſerv'd nothing new, except that their taſte kept good, but was a little ſowriſh, and that they yielded a little water.

The 24*th* of *June* I included ſome *Cherries*, to the number of 25 or 30, in a Receiver which was almoſt filled with them. They all burſt but two. Two days after they had a little changed their colour, and thoſe two that before remain'd whole, were now burſt like the reſt. After that, I obſerv'd no more change in them, and I ſhall keep them alſo as long as I can.

The 20*th* of *July*, I included in the *vacuum* one *Cherry* with eleven great *Corants*. The Cherry burſt preſently, and after that, I found it not changed, only it appear'd turn'd, as the Corants alſo did: This is a beginning of putrefaction, which may be imputed to the Air that remains in the Receivers. Theſe fruits I ſhall alſo keep as long as may be.

The 27*th* of *July*, I included in the *vacuum* four *Raſberries* and three *Corants*. The latter appear'd alſo to be turn'd, and the Raſberries looked leſs freſh than they were. But 'tis now more than *five* months that I perceive no change in them. I mean to keep them likewiſe as long as I can.

Hitherto I had employed none but *ſmall* Receivers, which did juſt hold that little fruit I put in them, and the red Corants ſeem'd to keep well enough; ſo that one day I filled a great Glaſs (of the figure of Cupping-glaſſes) with them, hoping to keep that as well as the ſmall Receivers. But I was ſurpriſed, five days after, to ſee that bubles were formed in the Turpentin which I had put about the ſaid great Glaſs in the place where it was faſtned to its cover, and that theſe bubles were burſt outwards; and afterwards, having

ſeen that the cover held faſt to the Bolthead no longer, I made no doubt of the Corants having produced Air enough to lift up the ſaid great Glaſs, and to form in the Turpentin the bubles I had ſeen. I was confirmed in this thought, when I found by the ſmell that they had fermented. They were yet good, except ſome that had loſt almoſt all their taſte, and all their acidity.

The ſame thing hapn'd to me with a very ſmall Receiver, that could hold no more than one *Cherry* (of that kind we call *Bigarreaux*) and one red *Corant*. Theſe fruits yielded alſo Air enough to lift up their Receiver *ſeven* days after they had been included therein: And having reiterated this Experiment, I found the ſame ſucceſs; only this ſecond time the Receiver was not lifted up till the *eleventh* day. This effect is rather to be aſcribed to the Cherry than the Corant; becauſe I have kept Corants to the number of *eleven* in a ſmall Glaſs, and they did not raiſe it up. Whence it follows, that theſe *Bigarreux* yield much more Air than Acid fruit.

Another time I included ſome of the ſame kind of Cherries a whole great Glaſs full, and found, that from the *ſecond* day they had yielded Air enough to lift up the cover. I took away part of the Cherries, and included the reſt again. This ſecond time they did not raiſe the Glaſs till the *eighth* day. The Cherries looked fair, but they had loſt much of their taſte, and afterwards they were ſpoiled in leſs than an hour.

I did alſo one day include three *Pears*, of that ſort we call *Rouſſelet*, in a like figured Glaſs, which could hold no more. They lifted up the Glaſs at the end of *five* days, and they were not changed, only one of them was a little ſofter.

Another time I put a *Peach* in ſuch a Glaſs emptied of Air, with a Gage to it; and I found, that the firſt *ſix* hours the Quickſilver in the Gage was riſen about an inch. Yet it was not till the *thirteenth* day that the Glaſs was lifted up; and the Peach appeared to have kept very well till then; but after that, it rotted in a very little time.

I did once put up ſome *Bread* with a Gage; but I found not that for the ſpace of a whole month it had yielded any Air; ſo that I took it out, and found it yet good; only it had a little taſte of muſtineſs, which yet appeared not at all to the Eye, and whereof the cauſe may be adſcribed to that little Air that might reſt in the Receiver.

One

One day I included a piece of *roaſted Mutton* with a Gage, and found, that in *four* days it had yielded no Air; but after my abſence of ſix weeks I ſaw the Mercury was riſen to the middle of the Gage; and having taken out the meat, I found it of a very ill ſmell.

Two days after, I included a piece of *raw Beef* and a Gage with it, and I ſaw, that in two days the Quickſilver was riſen an inch in the Gage; and after ſix weeks abſence, I found, the Mercury was got almoſt to the top of the Gage, and that this meat had contracted a much worſe ſmell than that which had been roaſted.

I alſo kept for *fifteen* days a piece of freſh *Butter* in *vacuo*, and I found, that it ſmelt more ſtrong than when I firſt put it in: But yet it could be ſtill eaten upon bread; whereas another piece of Butter, which at the ſame time I had kept in the Air, was altogether unfit to be eaten.

Theſe are almoſt all the Experiments I have made touching the Conſervation of Bodies in *vacuo*. The Gentlemen of our *Royal Academy*, who ſaw moſt of them *July* laſt, thought them worthy to be entred in their Regiſter, eſteeming, that beſides the conſequences they might afford for Natural Philoſophy, ſome other utilities might alſo be drawn thence. For, ſince that ſome Bodies do better keep there than others, ſome may poſſibly be found, that will keep there altogether well, and others that will there keep well enough to be tranſported into places where they could not be had elſe.

A Letter of Mr. Flamſteed, *Profeſſor Regius of Aſtronomy in* London, *to Sir* Jonas Moor *Knight, &c. containing his Obſervations of the late* Lunar Eclipſe, *on* Decemb. 21. 1675.

Illuſtri Viro

Domino *Jonæ Moor*, Equiti Aurato, Rei Tormentariæ per *Angliam* & *Hiberniam* Superviſori Generali, *Joh. Flamſtedius*, Bene agere & rectè valere.

NIſi Cœlum à Meridie, hunc Defectum præcedente, nubibus denſiſſimis, pluviâ continuâ, & vento validiſſimo inhorreſcens, omnem ferè ſpem optatæ ſerenitatis abſtuliſſet, itérque huc per flumen adnavigantibus periculoſum admodum reddidiſſet, plus tibi propter Miniſtri

stri tui peritioris promissam societatem, hac Observatio debuisset; quem cùm Tempestas Londini *detinuerit, servum adhibere coactus fui, quo vix rudior esse potest, paucioribúsque quàm secus vellem animadversionibus meipsum habere contentum. Circa sextam pomeridianam separatæ adeò nubes, ut per præterlabentium hiatus Lunam aliquando languidè, per vapores crassiusculos, emicantem cernere liceret; exinde spem concepi aliquam, ejus ad 20^am Horum appulsum circa octavam observandi; sed vapores facti densiores, & recurrentes frequentiores nubes, eam reddidere frustraneam: Nolui tamen omnem spem abjicere defectum observandi, sed cum servo ad undecimam evigilavi; tunc autem cùm Luna per aliquod tempus sub nubibus accumulatis fuisset abscondita, plureſque continuo ex Africo nubes exorirentur, quibus undique subtectum Cælum, ut nulla spes futuræ serenitatis esset residua, fruſtra, si diutius morarer, me fore putavi: Servo propterea ad me evigilandum relicto, domum me contuli; postquam ipsi injunxeram, ut, si qua melioris spes serenitatis effulgeret, me veniret accersitum: Sed vix duas horas decubueram, cùm me expergefactum venit, clarè nunc splendere Lunam, elatâ & mihi optatâ voce nuncians. Experrectus, per cubiculi fenestram Lunæ limbum penumbris offuscatum vidi; ad instrumenta propterea properans, Ipsius jam diametrum ad digiti ferè unius quantitatem deficientem inveni; exinde sequentes novempedali tubo habui observationes; Lunâ tardè plærunque per vapores emicante, qui adeo penumbram aggravare visi sunt, ut difficillimum esset eam ab umbra vera discriminare, nubibus etiam interdum recurrentibus, & impedientibus.*

Hora correcta horologii.	*Decembris 21. p. m.*
h ′ ″	
14. 29. 30	*Inter Cuspides* 2085=17′. 16″.
14. 55. 45	*Hæmum fere tetigit.*
15. 00. 30	*Hæmum certe tetigerit.*
15. 11. 30	*Cuspis dexter à Mareotide* 1235=10′. 14″.
15. 35. 00	*Partes lucidæ circiter* 2800=23. 11. *vel paulo forsan amplius; difficile enim erat admodum, umbræ veræ terminos per aerem, vaporibus fœdatum, definire.*
15. 42. 30	*Umbra prope Macram.*
15. 52. 45	*Inter cuspides circiter* 2288=18′. 57″.
16. 07. 15	*FINIS: Limbus enim apparuit, & nihil videbatur in rotunditate Lunæ desiderari.*

Limbus

h	′	″	
16.	08.	00	*Limbus admodum dilucidè per tubum conſpectus.*
16.	15.	30	*Penumbra, quæ nudis oculis Eclipſin referebat.*
16.	19.	30	*☽ capta diameter* 3757=31′. 05″. *ſed vix ſatis certa; ventus enim fortior tubum hinc inde agitans, haud adeò ſtabilem eum tenere permiſit ut iterari potuerit & accuratior fieri Menſura; quam tamen haud multum à veritate abeſſe putem.*
16.	23.	00	*Etiamnum, & poſtea, limbus ab Eclipſi derelictus obſcurior videbatur ac alter: Deinde cæpi*

Corſicæ à limbo ☽ remoto diſtantiam 2737=22′. 37″.
limbus ejus proximus à proximo lunæ 1045=8. 39.
Sinæ limbus remotior à Lunæ proximo 599=4. 58 *bona.*
Lacus nigri majoris Medium à limbo proximo 452=3. 45.

Notavi præterea.

Quòd umbra ſemper longe diſtinctior apparuit ad cornua quàm alicubi in facie Lunæ: In prima obſervatione, vel paulo antè, Cornua fuêre horizonti parallela.

Tunc etiam Porphyrites, *& Lacus Niger Major, æqualiter ex umbra extitêre, longitudinem ſcilicet circiter Mareotidis.*

Nunquam tamen Porphyriten *ſuperavit in hac Eclipſi; altè illum in penumbram merſum vidi, ſed tempus, adjutore perito deſtitutus, notare non potui.*

In ſumma Eclipſi ad Corſicam *ferè umbra pertigerit; nunquam tamen eam extinctam vidi, ſed alté adeò in penumbra immerſam, ut ægrè eam potuerim diſcernere: Sed impediebat forſan aer; clariorêmque & ab umbra credo viderint remotiorem, quibuſcunque in aere defæcatiore defectum hunc conſiderare contigerit.*

Nec unquam umbra vera Inſulam Macram *pervagabatur, ſed Penumbra duntaxat denſa, per quam difficile erat ipſam percipere.*

Imminente exitu in eam intentus, ſervum elatâ voce minuta ab horologio indicata pronunctare juſſi, quo facilius in proxima camera momenta obſervationum cognoſcerem. Sic hora 16ʰ. 05½′ *etiamſi aer peropportunè factus fuerit ſerenior, limbum tamen videre non potui; nec cum numeraret* 16ʰ. 6′½; *ſed hora* 16ʰ. 7′. *videre me putabam limbi lucem ſed languidiſſimam, & ægrè admodum; hora* 16ʰ. 7′. 15″.

certior

certior factus sum ex umbris emersisse, nec aliquid in ejus rotunditate desiderari: Ergo tunc Finem *observatum statuo. Horâ* 16h. 8'. *dilucidè admodùm limbus apparuit.*

Exibat umbra juxta Lacum hyperboreum superiorem *manente Penumbrâ, quæ Eclipsin nudis oculis exhibebat usque* 16h. 15'½; *sed limbus ab Eclipsi derelictus limbi oppositi claritudinem recuperavit non nisi hora* 16h. 28'. *vel serius.*

Tempora phasium correcta, ab Altitudinibus Arcturi & Lucidæ Coronæ, Quadrante Telescopico, pedum trium & amplius Radio, captis; quibus, clarè aliquando in altero Cæli cardine emicantibus, captandis incubui, quoties Lunam subière nubes.

Initium *Eclipsis accidit antequam ad Instrumenta veni: Quod tamen* Londini *in vico* Wintonienſi *observavit* Edmundus Halleius, *cùm Lunæ limbus superior à vertice distaret gradus* 39°. 51'; *unde horam supputavit* 14h. 16'.
alto eodem 41. 1 *Cornua horizonti parallela.* 14. 25.
54. 12 —————— 15. 58; *cùm unum vel alterum minutum deficeret, in diametro Lunæ ipsam Nubes subierè, sub quibus delituit, donec ex umbra penitus evaserat; sic ipsi non conspectus fuit finis; ut neque* Johanni Coelsono, *qui in vico* Wappingensi, *ad* Anachoresin, (*Angl.* the Eremitage,) *limbum Lunæ deficientem aliquantulum vidit hor.* 14h. 17¾; *nubibus tamen impeditus* finem *videre non potuit; è quibus tamen cùm eluctata esset hor.* 16h. 9'. 25''. *ex umbra vera ipsam exiisse comperit, densâ duntaxat Penumbrâ remanente.*

Quomodo calculus meus cum his observationibus consentiat, in alia Epistola ostendam: Quomodo Exterorum observationes, priori forsan aere factæ, tum iis congruant, scire plurimum cupio, & quotidie audire expecto. Tu interea, Vir dignissime, res, ut cæpisti, Astronomicas promovere, mihique favere, perge.

Greenovici, Decemb. 24.
1675.

A

A Letter of Mr. Franc. Linus, *written to the Publiſher from* Liege *the* 25th *of* Febr. 1675. ſt.n. *being a Reply to the Letter printed in* Numb. 110. *by way of Anſwer to a former Letter of the ſame Mr.* Linus, *concerning Mr.* Iſaac Newton's *Theory of Light and Colours.*

Honoured Sir,

IN yours of *Dec.* 17. which I received about the end of *Jan.* you ſay, I may reſt aſſured, *Firſt*, that the Experiment was made in clear days. *Secondly*, that the Priſm was placed cloſe to the hole, ſo that the light had no room to diverge: And *thirdly*, that the Image was not Parallel (as I conjectured) but Tranſverſe to the Axis of the Priſm. Truly, Sir, if theſe Aſſertions be admitted, they do indeed directly cut off what I ſaid of Mr. *Newton*'s being deceived by a bright cloud. But if we compare them with Mr. *Newton*'s Relation of the Experiment in the *Phil. Tranſactions*, *N.* 80 *p.* 3076. it will evidently appear, they cannot be admitted as being directly contrary to what is there delivered. For there he tells us, the ends of the coloured Image, he ſaw on the oppoſit wall, near five times as long as broad, *ſeemed to be Semicircular.* Now theſe Semicircular Ends are never ſeen in a clear day, as Experience ſhews. From whence follows againſt the *firſt* Aſſertion, That the Experiment was not made in a clear day. Neither are thoſe Semicircular Ends ever ſeen, when the Priſm is placed cloſe to the Hole; which contradicts the *ſecond* Aſſertion. Neither are they ever ſeen, when the Image is Tranſverſe to the length or Axis of the Priſm; which directly oppoſes the *third* Aſſertion. But if in any of theſe three Caſes, the Image be made ſo much longer than broad (as eaſily it may, by turning the Priſm a little about its Axis) near five times as long as broad, than the one End thereof will run out into a ſharp Cone or Pyramis like the flame of a Candle, and the other into a Cone ſomewhat more blunt; both which are far from ſeeming Semicircular: Whereas, if the Image be made not in a clear day, but with a bright cloud, and the Priſm not placed cloſe to the Hole, but in a competent diſtance from the ſame (as you ſee it placed in the Scheme of the Experiment in *N.* 84. *p.* 4091.) then theſe Semicircular Ends always appear with the ſides thereof ſtraight lines juſt as Mr. *Newton* there deſcribes them. Neither

is the length of the Image Transverse, but Parallel to the length of the Prism. Out of all which evidently follows, that the Experiment was not made in a clear day; nor with the Prism close to the Hole; nor yet with the Image Transverse (as is now affirmed,) but by a bright Cloud, and a Parallel Image (as I conjectured;) and I hope you will also now say, I had good reason so to conjecture, since it so well agrees with the Relation. And Experience will also shew you, if you please to make tryal, as it was made, in a dark Chamber, and observe the difference between such an Image made by a bright Cloud, and another made by the immediate rayes of the Sun: For, the former you shall always find Parallel, with the Ends Semicircular; but the latter you shall find Transverse, with the Ends Pyramidical, as aforesaid, whensoever it appears so much longer than broad.

More might be said out of the same Relation, to shew that the Image was not Transverse. For, if it had been Transverse, Mr. *Newton*, so well skilled in Opticks, could not have been surprised (as he says he was) to see the length thereof so much to exceed the breadth; it being a thing so obvious and easie to be explicated by the ordinary Rules of Refraction. That other place also, in the next *page* 3077. (where he says, the Incident Refractions were made in the Experiment equal to the Emergent,) proves again that the said oblong Image was not Transverse, but Parallel. For it is impossible, the Transverse Image should be so much longer than broad, unless those two Refractions be made very unequal, as both the computation according to the common Rules of Refraction, and Experience testifie. Wherefore Mr. *Newton* had no reason to tax (in *pag.* 4091.) P. *Pardies* of Hallucination, for making in *page* 4088. those two Refractions very unequal: For, that learned Optike very well saw, that in a clear day so great an inequality of length and breadth could not be made, unless those two Refractions were also made very unequal. These places, I say, might be added to the former, and further here explicated if need were; but there being no need, I cease to detain you any longer herein.

Mr.

Mr. Isaac Newton's *Considerations on the former Reply; together with further Directions, how to make the Experiments controverted aright: Written to the Publisher from* Cambridge, Novemb. 13. 1675.

SIR,

WHen you shew'd me Mr. *Line*'s second Letter, I remember I told you, that I thought an answer in writing would be insignificant, because the dispute was not about any Ratiocination, but my veracity in relating an Experiment, which he denies will succeed as it is described in my printed Letters: For this is to be decided not by discourse, but new tryal of the Experiment. What it is that imposes upon Mr. *Line* I cannot imagin; but I suspect he has not tryed the Experiment since he acquainted himself with my Theory, but depends upon his old notions taken up before he had any hint given to observe the figure of the coloured Image. I shall desire him therefore, before he returns any answer, to try it once more for his satisfaction, and that according to this manner.

Let him take any Prisme, and hold it so that its Axis may be perpendicular to the Sun's rays, and in this posture let it be placed as close as may be to the hole through which the Sun shines into a dark room, which hole may be about the bigness of a Pease. Then let him turn the Prism slowly about its Axis, and he shall see the colours move upon the opposite wall first towards that place to which the Sun's direct light would pass, if the Prism were taken away, and then back again. When they are in the middle of these two contrary motions, that is, when they are neareſt that place to which the Sun's direct ray tends, there let him stop; for then are the rays equally refracted on both sides the Prism. In this posture of the Prism let him observe the figure of the colours, and he shall find it not round as he contends, but oblong, and so much the more oblong as the Angle of the Prism, comprehended by the refracting plains, is bigger, and the wall, on which the colours are cast, more distant from the Prism; the colours red, yellow, green, blew, purple, succeeding in order not from one side of the figure to the other, as in Mr. *Line*'s conjecture, but from one end to the other; and the length of the Figure being not parallel but tranverse to the Axis of the Prism. After this manner I used to try the Experi-

ment: For I have try'd it often; ſometimes to obſerve the circumſtances of it, ſometimes in order to further Experiments, and ſometimes to ſhow it to others, and in all my tryals the ſucceſs was the ſame. But whereas Mr. *Line* thinks, I tryed it in a cloudy day, and placed the Priſm at a great diſtance from the hole of the window; the Experiment will not ſucceed well if the day be not clear, and the Priſm placed cloſe to the hole, or ſo near at leaſt, that all the Sun's light that comes from the hole may paſs through the Priſm alſo, ſo as to appear in a round form if intercepted by a paper immediately after it has paſt the Priſm.

When Mr. *Line* has tryed this, I could wiſh, he would proceed a little further to try that which I call'd the *Experimentum Crucis*, ſeeing (if I miſ-remember not) he denies that as well as the other. For when he has tryed them (which by his denying them, I know he has not done yet as they ſhould be tryed) I preſume he will reſt ſatisfied.

Three or four days after you gave me a ſight of Mr. *Line*'s ſecond Letter, I remember I thereupon ſhow'd the firſt of theſe two Experiments to that Gentleman whom you found with me, when you gave me that viſit, and whilſt I was ſhewing it to him, *A. H.* (a member of the *R. Society*) came in and I ſhewed it to him alſo. And you may remember, that *R. H.* two or three years agoe in a Letter read before the *R. Society*, and tranſmitted to me, gave teſtimony not only to the Experiments queſtioned by Mr. *Line*, but to all thoſe ſet down in my firſt Letter about Colours, as having tryed them himſelf; and when you read Mr. *Line*'s Letter at a meeting of the ſaid *Society*, and was pleaſed to do me the favour to propound the Experiment to be tryed in their preſence, *R. H.* ſpake of it to them as a thing not to be queſtioned. But if it have not yet been tryed before them, and any of them, upon Mr. *Line*'s confidence, doubt of it, I promiſe when I ſhall have the happineſs to be at any more of their Aſſemblies, upon the leaſt hint, to ſhew 'em the tryal of it; and I hope, I ſhall not be troubleſome, becauſe it may be tryed (though not ſo perfectly) even without darkning a room, or the expence of any more time than half a quarter of an hour; although, if Mr. *Line* perſiſt in his denyal of it, I could wiſh it might be tryed ſooner there, than I ſhall have an opportunity to be among them.

An

An Extract of another Letter of Mr. Newton, *written to the Publisher the* 10th *of* January 167⅘, *relating to the same Argument.*

BY Mr. *Gascoin*'s Letter* one might suspect, that Mr. *Linus* tryed the Experiment some other way than I did; and therefore I shall expect, till his friends have tryed it according to my late Directions. In which tryal it may possibly be a further guidance to them, to acquaint them, that the Prism casts from it several Images: *One* is, that *Oblong* one of *Colours* which I mean; and this is made by two Refractions only. *Another* there is, made by two Refractions and an intervening Reflexion; and this is *Round* and *Colourless*, if the Angles of the Prism be exactly equal; but if the Angles at the Reflecting base be not equal, it will be *colour'd*, and that so much the more, by how much unequaller the Angles are, but yet not much *unround*, unless the angles be very unequal. A *third* Image there is, made by one single Reflexion, and this is always *round* and *colourless*. The only danger is in mistaking the *second* for the *first*. But they are distinguishable not only by the Length and Lively colors of the *first*, but by it's different Motion too: For, whilst the Prism is turned continually the same way about it's *axis*, the *second* and *third* move swiftly, and go always on the same way till they disappear; but the *first* moves slow, and grows continually slower till it be stationary, and then turns back again, and goes back faster and faster, till it vanish in the place where it began to appear.

If without darkning their Room they hold the Prism at their window in the Sun's open Light, in such a posture that it's *axis* be perpen-

* This Letter was written to the Publisher, *Decemb.* 15. 1675. from *Leige*, where Mr. *Gascoines*, having been a Scholar of Mr. *Linus*, now deceased, resides. In it are contained these words, to which Mr. *Newton*, to whom it was communicated, seems here to have respect; *viz.* Mr. *Linus tryed the Experiment again and again, and called divers on purpose to see it, nor ever made difficulty to shew it to any one, who either by chance came to his chamber as he was doing it, or shewed the least desire to see the same. So that, for point of Experience, Mr.* Newton *cannot be more confident on his side, than we are here on the other; who are fully persuaded, that, unless the diversity of placing the Prism, or the bigness of the Hole, or some other such circumstance, be the cause of the difference betwixt them, Mr.* Newton's *Experiment will hardly stand.*

perpendicular to the Sun-beams, and then turn it about its *axis*, they cannot miss of seeing the *first* Image; which having found, they may double up a paper once or twice, and make a round hole in the middle of it about $\frac{1}{2}$ or $\frac{3}{4}$ of an inch broad, and hold the paper immediately before the Prism, that the Sun may shine on the Prism through that hole; and the Prism being stay'd, and held steddy in that posture which makes the Image Stationary; if the Image then fall directly on an opposite wall, or on a sheet of paper placed at the wall, suppose 15 or 20 foot from the Prism, or further off; they will see the Image in such an *Oblong* figure as I have described, with the *Red* at one end, the *Violet* at the other, and a *Blewish green* in the middle: And if they obscure their Room, as much as they can, by drawing curtains or otherwise, it will make the Colours the more conspicuous.

This direction I have set down, that no body, into whose hands a Prism shall happen, may find difficulty or trouble in trying it. But when Mr. *Linus*'s friends have tryed it thus, they may proceed to repeat it in a dark Room with a *less* hole made in their window shut. And then I shall desire, that they will send you a full and clear description, How they tryed it, expressing the length, breadth and angles of the Prism; its position to the Incident rays and to the window shut; the bigness of the hole in the window shut through which the Sun shined on the Prism; what side of the Prism the Sun shin'd on; and at what side the light came out of it again; the distance of the Prism from the opposite paper or wall on which the Refracted light was cast perpendicularly; and the length, breadth, and figure of the space there illuminated by that light, and the situation of each colour within that figure. And, if they please to illustrate their description with a Scheme or two, it will make the business plainer. By this means, if there be any difference in our way of experimenting, I shall be the better enabled to discern it, and give them notice, where the failure is, and how to rectifie it. I should be glad too, if they would favour me with a description of the Experiment, as it hath been hitherto tryed by Mr. *Linus*, that I may have an opportunity to consider, what there is in that which makes against me.

So far Mr. Newton; which was thought fit to make publick with the rest, that so the Curious every where, who have a mind to try the Experiment, may find the fuller directions for their tryal.

An

An Accompt of ſome Books:

I. *PHARMACEUTICE RATIONALIS, ſive Diatriba de MEDICAMENTORUM OPERATIONIBUS in Humano Corpore; Pars Secunda; Auth.* Tho. Willis *M. D. &c. E Theatro Sheldoniano.* 1675.

THis Learned and Worthy Author (whoſe Death may certainly be reputed a publick loſs, and a detriment to the very Faculty of Phyſick,) ſaw but a very few dayes before his deceaſe this Book of his finiſhed in the Preſs; to which, if Heaven had thought good to have ſpared him longer amongſt us, he would doubtleſs have added many other Philoſophical and uſeful Pieces, for the improvement of Knowledge and the Art of Phyſick. But ſince that is denied us, we muſt content our ſelves with what he hath left behind, which indeed is of very great value, and ſpeaks the Learning and Merit of the Author to admiration.

He had not long ſince publiſh't the *Firſt part* of this Argument, of which an Account was given in *Numb* 99. of theſe *Tracts*: We have now before us the *Second part* thereof, wherein the Author undertakes to give a Reaſon of the Operation of ſuch Remedies as have a reſpect to ſome Peculiar part of the Body, or to ſome Singular Diſeaſe, and are by ſome Specifique virtue or operation directed to thoſe Ends: And in doing this, he chiefly inquires into the Reaſon and Manner of the Operation of ſuch Medicins as are Pectoral, wont to be preſcribed againſt Coughs, Conſumptions, Catharr's, Aſthma's, and the like morbid Affections of the *Thorax*.

To this he premiſes, as a Ground-work, the Anatome and Conſideration of the ſtructure of thoſe Parts, their Uſes and Functions.

In the Anatomical part, he doth with admirable curioſity and incomparable accuracy deſcribe and diſcourſe upon the wonderful Fabrique of the Lungs, which, with the Excellent *Malpighius*, he makes to be, in their whole ſubſtance, fiſtulous, and compoſed of nothing but tubes of different kinds and ſizes; which, though they ſeem to be ſtrangely complicated, and variouſly perplexed, yet are every where continuous, and running out with a mutual relation and habitude to one another, do orderly and regularly convey and diſpoſe up and down the Air, Blood, Lympha, and Animal Spirits, for their ſeveral and reſpective Uſes, Theſe

These parts are represented by very exact *Figures*, and the matter for these Figures is furnish't by the Ingenious and Diligent Dr. *Edmund King*, with great skill and dexterity; as the Author himself acknowledges in the Dedication of this Book.

From the Conformation of the *Lungs* and the parts and Vessels thereof, the Author infers, that the *Use* of the Lungs seems to him to be; That the Blood may be through the smaller Vessels, like so many little rivulets, displayed and exposed in all its parts, and all these parts meet with the Nitrous particles of the Air, and be inspired with Vitality from the same.

Having explained the *Organs* of Respiration, he searches into the *Cause* of that constant vicissitude of the *Systole* and *Diastole*; and having assigned it to be the Animal Spirits, rushing out of the tendons into the carneous fibres, to perform the Contraction of the Muscles, and receding back out of *these* into *those*, to perform their Relaxation: Having, I say, done this, he shews the different cause of the *Spontaneous* aud the meer *Natural* function in Animals, deriving the *former* from those Animal Spirits that are dispens'd by the *Cerebrum*; the *latter* from those that are furnish't by the *Cerebellum*; proving withal, that Respiration is, as 'twere, a mix'd work partaking of both functions, the spontaneous and natural.

After the examination of the structure of the Lungs and the Parts thereof, serving for Motion and the entertainment of Life; he proceeds to consider the various ways and accidents, by which that manifold *apparatus* of organs may be vitiated, and consequently the functions, depending therefrom, perverted; esteeming, that this Pneumonique Engin, lodged in the breast, whereby the Air being inspired, we maintain the life of the blood and its motion and heat, is exceedingly subject to depravation; as a Watch that is with great Art composed of a spring, ballance, wheeles, strings, &c. is very liable to disorder.

Here he shews, How the Uses and Ends of Respiration may be spoiled; which is done chiefly two ways: *First*, when the Blood does not duly circulate through the Heart and the Pneumonique Vessels; which may sometimes be caus'd within the right ventricle of the heart, or the Pneumonique Arteries, sometimes also within the left ventricle, or the pulmonary veins: *Secondly*, when the Air is either not duly inspired and expired in or out of the Windpipe and its branches: Of each of which as there are various

cases,

caſes, and cauſes, and ways, ſo the chief of them are here learnedly diſcuſſed; with an Animadverſion on the *Sylvian* opinion concerning the bloods effervescence in the Lungs. Here occur various Inquiries; 1. How the blood may be impeded ſometimes by too little, ſometimes by too great, an accenſion; ſometimes alſo by the depravation of it's *Craſis*, the texture of it being often too looſe (whence ſtore of ſeroſity, and corruptive *miaſmata* are depoſited in the Lungs) often too cloſe (whence ariſe Fevers, Pleuriſies, Peripneumonia's.) 2. How the blood may be impeded by the fault of the Heart, when the Spirits of it are either deficient or move irregularly. 3. How it may be hindered by the obſtruction of the paſſages, which may alſo happen divers ways, and from divers cauſes. 4. How it may be impeded by the Air, either wanting, or corrupted: Where are noted the defects and vices of the Air, and the many obſtructions and other ill effects proceeding from thence, amongſt which are Catharrs, Aſthma's, Coughs, Atrophies or Conſumptions.

Theſe things being diſpatched, he advances to the chief deſign of this work, which is the *Pathology*, and treats largely of the remedies proper to cure thoſe indiſpoſitions and diſeaſes of the *thorax*, and to render an Accompt of the manner of their operation.

And in this part he conſiders the origine, nature, ſymptoms and remedies of the ſeveral ſorts of PHTHYSICAL maladies, of Blood-ſpitting, Peripneumonia's, Pleuriſies, Empyema's, Aſthma's, Thoracical Dropſies. In all which the Reader will find many conſiderable particulars, touching Tabifique matter and it's cauſes; as alſo concerning Tranſpiration impeded; the various Incongruities of the inſpired Air; the Congruity of a ſulphureous Air, and of ſulphureous Medicines to Conſumptive bodies, with the reaſon thereof: Further, concerning ſtrange ſorts of Coughs, and their Cures; divers grievous Aſthma's, and ſome convulſive ones, and the way of curing them; a very odd caſe of an *Aſcites* in the Breaſt, cauſed by the rupture of ſome Lympheducts there, follow'd by an *audible* dropping of the Liquor into the cavity of the part. And, as this Diſeaſe of the Pectoral Dropſie, ſo all others of the *Thorax* here diſcourſed of, are illuſtrated with very remarkable Caſes and Hiſtories.

In the next *Section*, the Author conſiders the Diſeaſes of the

Viscera, and delivers the Remedies, and Ways, and Reasons of Curing them, as of the former. Here occurs *first* the *Icterus*, together with *Sylvius*'s and the Author's opinion touching the Cause thereof; to which are subjoyned the *Sylvian* Empirical remedies of the same, together with the Authors method of performing the Cure thereof. *Secondly*, the *Dropsy*, and the various kinds, differences, causes and cures of it; with a Note, that the *Tympanites* is properly no *species* of Dropsy, nor caused from Winds, but from an inordinate Inflation of the membranous parts, caused by the disordered Animal Spirits influencing those *viscera*.

In the following *Section*, he treats *first*, of *Phlebotomy*, it's Uses and Effects; whether to be used in continual putrid Fevers; what Cautions to be observed in Blood-letting, in regard of the part to be open'd, as also in respect of the Disease, Age, Quantity, *&c*; why in some Cases 'tis not at all to be used; why, when made too sparingly, 'tis often noxious and heightens the Fever, *&c*. *Secondly*, of *Hæmorrhagies*, why not always to be stopped, and how many ways they may be stopped. *Thirdly*, of *Vesicatories*, their varieties, uses and effects, and with what Constitutions they agree best, and with which not at all. *Fourthly*, of *Fistula*'s or Issues, *viz*. what Humors they evacuate; in what diseases they are most conducive; and for what bodies they are not convenient; with a Note upon that vulgar Error, which insinuates, that *Issues* dispose to barrenness. *Fifthly*, of *Cutaneous* Diseases; their varieties and cures; and particularly of the *Psora*, and its nature, origine, cure. *Sixthly*, of the *impetigo* or *Lepra Græcorum*, its rise, property, and remedies.

To sum up all, the Author hath *first*, with great care and exactness viewed in the human Body those Parts and Places where the Medicines are to perform their operation: *Then* he hath been sollicitous, according to the *phænomena* of all and every part, discover'd by his Anatomical Observation, to rende solid and genuin *hypotheses* of the Diseases, by him designed to cure; and having made it his business to derive the Causes of Maladies from their very Sources, he hath every where endeavoured to shew from what disposition of Blood and Humors, from what affection of Animal Spirits, and from what constitution of Fibers and other solid parts, every sickness he treats of proceeds. And having laid those things for a solid foundation, to build thereupon

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a firm ſuperſtructure of his *Pharmacentice*, he hath laſtly deliver'd abundance of Medicaments, reſpecting thoſe examined Parts and Regions of the body, and their peculiar Indiſpoſitions; which Remedies are both Simple and Compounded, Old and New, Dogmatique and Empirique: Of the preparations, operations and effects of all which he ſubjoyns their reſpective Reaſons.

II. *COLLEGIUM EXPERIMENTALE ſive CURIOSUM, in quo primaria hujus Seculi Inventa & Experimenta Phyſico-Mathematica, A.* 1672. *quibuſdam Naturæ Scrutatoribus ſpectanda exhibuit & ad cauſas ſuas naturales demonſtrativâ methodo reduxit* Johannes Chriſtophorus Sturmius, *Mathem. ac Phyſ. in Academ. Altdorfina Prof. P. &c.* Norimbergæ, *A.* 1676. *in* 4°.

THe Learned Author of this Piece, in the Invitation he made to ſome Students in Philoſophy, at *Altorf* in *Germany*, importing that they would liſt themſelves under his conduct for the Examination and Conſideration of ſome of thoſe Diſcoveries and Experiments made of late years, takes notice, that in this one Age, not yet elapſed, there hath been a far greater progreſs made in Natural Philoſophy, than in many Ages before, and that by means of that happy *Experimental* Method, embraced and exerciſed by the *Royal Societies* of *England* and *France*, and the noble *Colledges* of *Rome*, *Florence*, *Venice*, &c. by which Method, he ſaith, the Diſputacious way of wrangling about mere Scholaſtical and fruitleſs notions being laid aſide, Things themſelves from the inmoſt Receſſes of Nature have been ſearched into, and not a few of them diſcover'd and brought to light. Of which that he might enamour and poſſeſs his Auditors, he reſolved to take the pains of propoſing and explaining them to thoſe that were inclined to ſuch Studies; and having ſo done, to make publick the reſult of all thoſe particulars: Which is the thing he hath now executed in this Volume: Wherein the *Reader* will find XVI *Eſſays*, of a Philoſophical Nature, by him treated of; which he acknowledges to have been, at leaſt for the moſt part, handled, experimented and diſcourſed of, by

ſome of the moſt Eminent Philoſophers of this Age; amongſt whom he names the Illuſtrious *Bacon*, *Des Cartes*, *Torricelli*, *Boyle*, *Roberval*, *Paſchal*, *Hugens*, and *Guerick*.

Of theſe XVI Eſſays,

The *firſt*, repreſents and explains the Diving Bell, its Structure and Uſe.

The *ſecond*, exhibits the chief Optique *Phænomena* of a Darkned chamber, and ſhews their Cauſes.

The *third*, relates the Effects of the Baroſcope or the *Torricellian* Quickſilver Tube, and withal gives the reaſons of them.

The *fourth*, ſhews ſome Experiments of ſome metallin weights floating, and without any other ſupport freely pendulous in Water and Air; reducing them to their Cauſes.

The *fifth*, repreſents both to the Eye and the Underſtanding ſome other Hydroſtatical *Phænomena*, about Glaſs-bubles, at firſt floating on the ſurface of the water, and afterwards ſubſiding by affuſed oyl, *&c.*

The *ſixth*, deduces ſome *Conſectaries* from the before aſſerted Spring and Weight of the ever-gravitating Air; and thoſe very Conſectaries prov'd by the ſenſe of the Eyes themſelves.

The *ſeventh*, contains ſome Experiments of a Glaſs-Tube, ſix and thirty feet high, filled with water, and declares their Cauſes from the *Æquilibrium* of the Air and ſo much Water.

The *eighth*, ſhews ſome *Phænomena* in very ſlender or narrow Tubes, *viz.* the Aſcent of water in them above its other ſuperficies; ſubjoining withal the reaſon thereof.

The *ninth*, exhibits the Effects, and declares the Cauſes of ſeveral ſorts of Thermometers.

The *tenth*, mentions a very paradoxical Experiment of *Franc. Lana*.

The *eleventh*, repreſents and reduces to its principles the Force of Mechanical Powers, particularly that of a certain ſlender wooden Engin, which he ſaith was of ſuch a power, that a Child of two years old, turning the handle thereof, did in his preſence lift up a weight of 100 *l.* and at another time, a weight of 200 *l.*

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The *twelfth*, discourses of an Art, *both* of *writing* any thing in any Tongue, to be read and understood by any Nation of what Language soever, *and* of *reading* and *understanding* any thing written in any Tongue.

The *thirteenth*, contains some considerable Effects and Experiments of the *Air-pump*, partly made by others, partly said by our Author to have been devised and tryed by himself; all reduced to their proper Causes.

The *fourteenth*, declareth the Uses and Reasons of the Effects of Hygrometers and Chronometers.

The *fifteenth*, explains the structure of Microscopes and Telescopes, comprobating their Effects from many Observations.

The *last*, exhibits divers pleasant Spectacles of a portable darkned Room, and of a Catoptro-Dioptrical Lantern, adding the genuin Reasons of them; and for an *Appendix* subjoyns his new, as he esteems it, Perpetual Almanack, comprehending not only the Immoveable Feasts fixed to certain days of the Months, but also the Moveable ones, of Easter, Pentecost, and the rest depending from them; as also the Motions of the Sun and Moon through the twelve celestial Signs, together with the Moons menstrual increases and decreases, *&c.*

Having dispatched this, he takes notice, that reflecting upon what he had done and discoursed in the former Papers, he found it not amiss to write some *Appendixes* to the *Essays* before recited, supplying therein *partly*, what in his Philosophical Colledg had been by word of mouth noted in reference to the above-mentioned phænomena and conclusions; *partly*, what had been thought fit to add to them by way of Illustration, upon a second perusal and examination of the same.

And in this part he *first* discourses more particularly of the diving Engin and Divers; and *then*, of the Weight of the Air, acknowledged by *Aristotle* himself to gravitate in its own place; alledging for that purpose out of *c.* 4. of his 4*th. Book de Cælo*, these remarkable words; ἐν τῇ αὐτῇ γὰρ χώρᾳ πάντα βάρος ἔχει πλὴν πυρὸς, καὶ ὁ ἀὴρ· σημεῖον δέ, ὅτι ἔλκει πλεῖον ὁ περιεσπασμένος ἀσκὸς τοῦ κενοῦ. *Thirdly*, of the *Hylarchical* principle of Dr. *Henry Moor*, which he examins; alledging, not to have yet *seen* what he *hears* Mr. *Boyle* hath written upon that Argument in *English*. *Fourthly*, of the new Pocket-

Pocket-watches, equivalent to Pendulum-Clocks; of which see *Numb.* 112. of these *Tracts*. To which are added many other particulars, which cannot be all taken notice of here; we shall only note further, that our Author in this part of his Book gives to those persons, to whom he professes himself obliged for their noble Experiments, and judicious Ratiocinations, more *particularly* their respective dues, than he had done in the first part.

III. *ENGLAND'S IMPROVEMENTS, in two parts*, &c. *by* Roger Cook, London 1675. *in* 4o.

THIS Author, appearing to be of a very publick Spirit, seems to have spent a great part of his Life in considering the ways of furthering the Publick Welfare of his Native Country, and in enquiring, for that end, into the present State of *England*, compared with other Countries: For, finding that mens business generally relates to, and arrives at, their Individual either profit or reputation, and that these are so intended by them, that their whole life is hardly enough to answer the desires running out for the one or the other, and that therefore a third person is necessary to undertake a business of so publick a nature; he resolved to set himself a part for such a work, as may make it out to considering men, that without *Freedom* of Trade, the Trade and Strength of a Nation cannot be rendered considerable; removing, before he enters upon the matter, that vulgar Objection, as if Trade and Commerce could, and must, only flourish in popular Governments.

Now this Piece consists of *two Parts*: In the *former* is discoursed, How the Kingdom of *England* may be improved in Strength, Employment, Wealth and Trade, by increasing the Value of Lands; the Revenue of the Crown and Church; Peace and Amity with Forreign Nations, without any Charge to the Subject. In the *latter* is represented, How the Navigation of *England* may be increased, and the Soveraignty of the *British* Seas more secured to the Crown of *England*.

What this Gentleman hath performed in these Weighty points, we must not presume to judge, but leave that to the Impartial and Judicious Reader to determine.

IV. *The*

IV. *The* COLLEDGE *of* PHYSICIANS VINDICATED, *and the* TRUE STATE *of* PHYSICK *in this Nation faithfully repreſented*, &c. *by* Charles Goodall, *M. D.* London, *for* Walter Kittelby *at the Sign of the* Biſhop's head *in St.* Paul's *Church-yard*, 1676. *in* 8o.

THIS Vindication of the eminently learned *Colledge of Phyſitians* of *London* from the Imputations lately charged upon them in a Paper, entituled the *Corner Stone*, &c. conſiſts of three parts, anſwering to as many Heads, as the Objections of their Adverſaries are reducible unto; *viz.* 1. That the ſaid Colledg is not eſtabliſhed by Law. 2. That the Proceedings of the ſame againſt Empiricks and Unlicenſed perſons is oppreſſive. 3. That the Phyſicians educated in Univerſities, and particularly the ſaid Colledg have been the great Hinderers of the Art of Phyſick; and more eſpecially of that of Chymiſtry.

Of the Anſwers to theſe three Accuſations we ſhall paſs by thoſe that relate to the *two firſt*, as being of a *Juridical* Nature, and conſequently not belonging to the cogniſance of theſe *Tracts*: But the Anſwer to the *third* Objection, whereby we are by the Learned and Ingenious Author enabled to underſtand the real Advantages of a regular Inſtitution of Methodical Practice, and the Danger of mere Empirical Adminiſtrations, we cannot but take notice of; foraſmuch as by ſhewing, that the ſaid *Colledge*, with thoſe other Learned Phyſicians educated in Academies, have not been hinderers, but the principal Promoters of the Art of Phyſick in Anatomy, Chymiſtry, and the Method of Curing; by ſhewing this, *I ſay*, our Author delivers many conſiderable particulars, relating to thoſe three main Pillars of the Medical Art: As *firſt*, that ſomething hath been done in *Anatomy*, both by Antients and Moderns, that hath conduced to the better Cure of Diſeaſes. *Secondly*, that the *Moderns* have improv'd the Anatomick part of Phyſick by their late diſcoveries. *Thirdly*, that Chymiſtry hath been practiſed by ſome of the greateſt Anatomiſts and Practiſers of our Age; of whom he names Dr. *Willis*, Dr. *Sylvius*, Dr. *Borrichius*, Dr. *Dimmerbroeck*, Dr. *Daniel Cox*. *Fourthly*, that

that the Noble Art of Chymistry owes its chief advancement to Physitians of Academick Education and to Collegiate Members, such as *Mynsicht*, *Beguinus*, *Hartman*, *Grulingius*, *Horstius*, *Schroderus*, *Quercetan*, *Mayerne*, *Zwelfer*, *Beccherus*, *Langelot*, *Borrichius*, *Du Clos*, *Vallot*, *Rugeley*, *Goddart*, *Merret*, besides those aforemention'd. *Fifthly*, that, whereas the Accuser will not allow the *London*-Colledge of Physicians any one particular improvement of the Art of Physick, our Answerer shews, 1. That those Doctrines which can acquaint us with the real constituent Principles of the Blood, and other humors and recrements of human Bodies, and with their various preternatural affections, must of necessity conduce to the improvement of the Practice of Physick. 2. That there was a particular improvement made in the *Art of Curing*, by Dr. *Glisson*, Dr. *Bates*, and Dr. *Regemorter*, by curing the *Rickets*.

As for the Usefulness and Necessity of *Method* in the Cure of Diseases, we shall not here speak of it, but referr to the Author himself.

London, Printed for *John Martyn*, Printer to the *R. Society*. 1675.

PHILOSOPHICAL TRANSACTIONS.

Februar. 21. 167⅝.

The CONTENTS.

An Experimental Discourse of Quicksilver *growing hot with* Gold; *by B. R. Some Observations on several Passages of the two last Months* Transactions; *relating to some, till now* un-observed, *Qualities in the Air*; to *the Mixing and Fermenting of Liquors in* vacuo; to *the History of Birds*; *the Anatomy of the Trunks of Vegetables*; *Baroscopes*, *&c. Some Experiments touching* Animals; *others, about producing Ice free from bubbles in* vacuo, *and giving by means of the* Air-pump *certain proprieties to things, which they never had before*; *others, touching Gun powder, and they way of discovering the quantity of Air contained therein, together with its degree of Compression in that body*, *&c. An Account of some Books*; I. *COURS d'ARCHITECTURE, Premiere partie*; *par M.* Francois Blondel. II. *Dr.* Henry Moore's *Remarks upon two late Ingenious Treatises*, *&c. An INDEX for the Tracts of this whole Year.*

Of the Incalescence of Quicksilver *with* Gold, *generously imparted by* B. R.

The Introduction of the Publisher.

THough the following discourse was by the Author of it made part of a short *Examen* of the supposed Sympathy between *Gold* and *Quicksilver*, (which it self belongs to another Treatise;) yet the worthiness of the subject, and the great curiosity that is observed among many Virtuosi, (not only *Chymists*, but others,) about *Mercurial* Preparations and Experiment, made me think I

might do them an acceptable piece of ſervice, if I could prevail with the Author to ſever them from the papers, whereto he had annex'd them, (but to which they ſeemed not abſolutely neceſſary) though upon the conditions he judg'd requiſite to inſiſt on.

And ſince I venture to impart before the time theſe things unto the Curious, I hope and deſire, they will be ſo equitable as to indemnifie me to the Author, and not fruitleſsly endeavour to put a perſon, that has already given ſo many proofs of his propenſity to gratifie Ingenious men, upon making unſeaſonable anſwers to any Verbal or Epiſtolary Queſtions about things, wherein ſome conſiderations, that he thinks are not to be diſpenſed with by him, do as yet injoyn him ſilence.

Now, to gratifie the Curious amongſt Strangers, as well as thoſe of our own Nation, the Publiſher was not unwilling to give this diſcourſe in Latin, as the Author hath been pleaſed to impart it in Engliſh.

Follows the Diſcourſe it ſelf.

Of Mercury *growing hot with* Gold; *Communicated by* B. R.

1. ——BUt that what I have hitherto ſaid, may not be drawn to the diſparagement or diſcouragement of thoſe Spagyriſts that poſſeſs or aſpire to the nobler *Arcana* of Gold and Mercury, I muſt mind you to take notice, that what I have objected againſt the ſuppoſed Sympathy of Gold and Quick-ſilver, is ſpoken only of common Mercury, that being It whoſe Sympathy with Gold is wont to be celebrated. And though perhaps, a good part of the things I have alledg'd will be found applicable even to true running Mercuries; yet I would not be thought to deny, that there may be

De *Mercurio* cum *Auro* incaleſcente, Diatriba *B. R.*

——*VErùm enimverò, ne quæ hactenus diſſerui eò torqueantur, ac ſi laudes animoſque viris illis Spagyricis demere velimus, qui Nobiliora Auri & Argenti Vivi arcana poſſident ambiuntve, monendus es mihi ut advertas, me quod contra ſuppoſitam Auri & Mercurii ſympathiam objeci, de* Vulgari *duntaxat* Mercurio *dictum velle, cùm ille ſit, cujus cum Auro ſympathia celebrari ſueverit. Et quamvis fortè magna à me dictorum pars, conſultâ experientiâ, ad nativum etiam Mercurium currentem extendi poſſit; non tamen cenſere Lectorem velim, negare me, dari Argentum vivum poſſe*

be a Quickſilver more ſubtle and penetrant than that which is common, and that thoſe Chymiſts, that ground the ſympathy of Gold and Mercury upon the Operations of a more Philoſophical Mercury, may likewiſe argue for it more ſpecioufly than Vulgar Mercury will enable them to do. And to let you ſee on this occaſion that I am not unkind to the Chymiſts, I will annex part of a Paper, written to a Friend to give him my Opinion about *Mercuries Incaleſcence with Gold.*

2. —And now I ſhall abruptly begin this Section with the conſideration of a Probleme much agitated among the Curious, eſpecially thoſe that pretend, whether truly or vainly, to have more than ordinary inſight into Chymiſtry: Among whom I find it hotly diſputed, whether or no there be any ſuch thing as a Mercury that will heat with Gold, that is, which by being barely mingled with that mettal reduced to fine parts, will, without the help of external heat, produce upon the commixture of thoſe two Bodies very ſenſible heat.

3. The Affirmative of this Queſtion is poſitively aſſerted by ſome Writers and others, that pretend to the Tranſmutation of Metals: For among theſe I have met *poſſe* Vulgari *ſubtilius & penetrantius, iſtoſque Chymicos, qui Auri & Mercurii Sympathiam niti volunt Mercurii* magis philoſophici *operationibus, contendere etiam pro ea multò ſpecioſius poſſe, quàm ſi* Vulgaris *duntaxat Mercurius adhibeatur. Atque ut hac occaſione teſtatum faciam, me viros Chymiæ addictos neutiquam averſari; ſubjungam hic ſcripti mei partem, ad Amicum quendam idcircò exarati, ut meam ipſi de* Mercurii cum Auro Incaleſcentia *opinionem depromerem.*

——— *Nunc verò abruptè Sectionem hanc ordiar Problematis cujuſdam diſcuſſione, quod diu multumque inter Curioſos fuit agitatum, eos inprimis, qui, ſive verè ſive falsò, obtendunt, ſe intimiores, quàm vulgo conceſſum eſt, Chymiæ receſſus adiiſſe: Inter quos id calidè diſceptari reperio,* Utrum ejuſmodi detur Mercurius, qui incaleſcat cum Auro, *id eſt, qui, dum nudè Metallo iſti, ad minutas admodùm partes redacto, commiſcetur, citra externi caloris adminiculum, factâ ſolummodò duorum illorum corporum cramate, ſenſibilem valdè calorem pariat.*

Hujus Quæſtionis Affirmativam *mordicùs tenent nonnulli Authores, aliique qui Metallorum Tranſmutationem ſibi vendicant; Inter hos quippe, nonnullos videre*

met with some that ascribe this vertue of Incalescence with Gold to the Mercuries extracted, as they suppose, from some compleat Metals, which are therefore in their Phrase styl'd *Mercurii Corporum*, or the *Mercuries* of the Metalline Bodies.

4. But the Negative part of the Question is more generally maintain'd, being not only embraced by far the greatest number of Philosophers and Physicians, but assented to by many of the more Learned *Spagyrists* themselves, especially the Modern, divers of whom have reckon'd this sort of Mercuries among the *Chimæra's* and *Non-Entia* of bragging Chymists. And I have the less wondered to find many Learned men so averse from believing this Incalescence of Mercury and Gold, because, having purposely enquir'd of several prying Alchymists, that have spent much labour, and many Trials, to find out things of this kind, and have of late years travelled into many parts of *Europe* to pry into the Secrets of other Seekers of Metalline Transmutations, they have apart ingenuously confessed to me, that they never actually saw any Incalescent Mercury, though they sometimes heard it boasted of by Alchymists; whose bold pretensions had the less weight with *mihi licuit, qui hanc Incalescendi cum Auro virtutem Mercuriis adscribunt, ex perfectis quibusdam corporibus, ut autumant, elicitis; quos idcircò* Mercurios Corporum, *sive Mercurios corporum Metallicorum, nuncupare solent.*

At Negativam *tuentur multò plures, iique non modò Philosophi & Medici, sed & ex ipsis Spagyricis doctrinâ clariores, inprimis ex neotericis & modernis, quorum non pauci hanc* Mercuriorum *familiam Chimæris & Non-entibus grandiloquentium Chymistarum accensent. Atque eò minùs mirabar, complures viros doctos adeò esse ab hoc* Mercuri cum Auro Incalescentiæ *assensu alienos, quia, consultò quæsiti à me plures ex Alchymistis sagacioribus, qui multum impenderant operæ, plurimaque Experimenta peregerant ad hujus generis arcana depromenda, quique per aliquot annos novissimos varias* Europæ *partes permearant, ut aliorum, qui Transmutationes Metallicas vestigant, secreta rimarentur, illi, inquam, singuli seorsim à me rogati ingenuè apud me fassi sunt, se revera nunquam* incalescentem ullum Mercurium *vidisse, licèt id quandoque jactatum ab Alchymistis audivissent; quorum jactabundi obtentus eò minùs apud me in hoc negotio valebant, quòd à longo jam tempore notaveram, quantam*

Fraus

with me in this matter, becauſe I had long taken notice, how great a confidence, fraud, or ignorance (for I would not think all thoſe *Cheats* that are *miſtaken*,) can give to ſome of that ſort of men that I am ſpeaking of. Inſomuch that one of them having impos'd upon an honeſt Chymiſt, well known and much employed, with a pretended incaleſcent Mercury, they had the confidence to bring it me to convince me of the Experiment; but upon due Trial, I found not any ſenſible degree of that great heat that was promiſed. Which miſcarriage was vainly pretended to be ſalved by I know not what unſatisfactory excuſes.

5. But notwithſtanding all this, having for the reaſons I have long ſince expreſſed in other Papers (and for ſome other Conſiderations that I have not judg'd fit to mention) lookt upon *Mercury* as a Body which is not neceſſarily ſo homogeneous as 'tis ſuppoſed, the Opinion I moſt lik'd of was, that of a poſſibility of an Incaleſcent Mercury. For notwithſtanding the vulgarly ſuppoſed Similar nature of Quickſilver, which I willingly confeſs to be great enough to be admirable, it was yet congruous to my Principles, that a Liquor, which in weight, colour, total volatility, &c. was anſwerable to all the eſſential Properties for which a body is called *Mercury*, might yet have an Fraus *vel* Ignorantia (*non enim omnes illos haberi* impoſtores *velim qui* hallucinantur,) *in nonnullis hujuſmodi, de quibus loquor, viris fiduciam parere poſſint*; *quæ ſanè tanta erat, ut illi, cùm eorum unus, bonæ frugis Chymiſtam, multis notum multiſque operam ſuam locantem, ſuppoſito* Mercurio incaleſcente *fefellerat*, *eò fiduciæ abriperentur*, *ut apud memet ſe ſiſterent*, *de Experimento illo me convicturi. At, re ut par erat explcratâ, nullum percepi ſenſibilem illius caloris gradū, quem promiſerant.*

Verùm enimverò, his omnibus nequicquam obſtantibus, *cùm ex rationibus dudum in alio ſcripto à me expoſitis, aliiſque de cauſis hîc non memorandis*, *Argentum vivum*, *corpus reputem*, *quod non neceſſariò tam ſit homogeneum, ac paſſim habetur*; *illa mihi opinio præ cæteris allubuit*, *quæ* Mercurii incaleſcentis poſſibilitatem adſtruit. *Etenim*, *non obſtante vulgò ſuppoſitâ Mercurii* (*ut ſic dicam*) *Similaritate*, *quam adeò eximiam eſſe puto*, *ut parere admirationem poſſit*, *meis tamen Principiis conſonum erat*, *Liquorem quendam*, *qui pondere*, *colore*, *totali volatilitate*, *&c. omnes referebat proprietates eſſentiales*, *quarum reſpectu corpus aliquod* Mercurii *nomine venit*, *habere tamen poſſe internam ejuſmodi*

partium

an internal constitution of parts, that might make it in some unobserved things considerably differing from common Mercury. And among these differing Qualities I did not know but one might well be, that of growing hot with Gold. And this Opinion I judg'd the more reasonable; because, having devised two waies (unpractised that I know of by any Chymist) the *one*, to to discover whether a clean and carefully distilled Mercury might not be a compounded Body, and have in it parts that were not; Mercurial and the *other*, out of such a fine distill'd Mercury to separate parts, and that in no despicable number, that are plainly heterogeneous; I found upon trial, that both the Methods I had thought on would succeed, which warranted me to think it possible, that a Mercury very fine and clean, and even purg'd by Sublimations and Distillations, may by Art have been made to assume and incorporate with it a multitude of heterogeneous Corpuscles, not to be discover'd, much less separated, (as those of *Tinn*, *Lead*, &c. may be) but by a skilful Artist.

6. This in the general may suffice to make me suspend my Judgment about the Probleme formerly propos'd, and to engage

partium diathesin, quæ in nonnullis hactenus non observatis insignem illi à Mercurio vulgari discrepantiam conciliare queat: Atque has inter Qualitates differentes nesciebam annon ea recenseri meritò posset, quâ incalescit cum Auro commixtus. Atque hanc Opinionem rationi eò magis consentaneam arbitrabar, quòd, excogitatâ à me duplici methodo (hactenus à Chymicorum nullo, quòd sciam, in praxin versâ,) unâ quidem, ut manifestum redderem, essetne purus curatéque distillatus Mercurius, corpus compositum, partesque contineret non-Mercuriales; alterâ verò, ex purificato ejusmodi & distillato Mercurio partes separandi non paucas manifestò heterogeneas; experiundo comperi, utramque illam methodum à me inventam successu gaudere: Id quod auctoramentum mihi haud leve erat, ut possibile existimarem, Mercurium valdè defæcatum, quin & per sublimationes & distillationes repurgatum, Arte posse eò redigi, ut assumat secúmque conflet heterogeneorum corpusculorum multitudinem, quæ nonnisi à perito Artis filio detegi, multò minus segregari queant (ut fieri de Stanneis, Plumbeis, *&c. corpusculis potest.)*

Hoc generatim sufficerit, ut meum de Problemate suprà propositio judicium suspendam, & ad experimenta sumenda *properem, quibus*

gage me to *make trials*, whether ſome of theſe heterogeneous particles that I found reducible with Mercury into a laſting Mercurial flux, might not ſo alter it as to diſpoſe it to heat with Gold. But this was not ſufficient to determine me to an *aſſent*; for to oblige me to admit incaleſcent Mercuries, it ought not to ſuffice, that 'tis poſſible or even probable, that there *may be* ſuch, but there was neceſſary ſome poſitive proof that there *are* ſuch; and that alſo through Gods bleſſing my Trials afforded me about the year 1652.

7. Some years after I was in poſſeſſion of this Mercury, I found in ſome of their Books, that Chymiſts call Philoſophers, ſome dark paſſages, whence I then gheſſ'd their knowledge of it, or of ſome other very like it; and in one of them I found, though not all in the very ſame place, an Allegorical deſcription of it, the greateſt part of which was not very difficult for me to underſtand; but not finding there any notice taken of the property of this Mercury to grow hot with Gold, I was induced to ſuſpect, that either they had not the knowledge of it, or judg'd it unfit to be ſpoken of. But you will, I ſuppoſe, expect from me rather Narratives than Conjectures. And indeed 'tis but rea-

quibus palàm reddatur, Annon aliquæ ex particulis illis heterogeneis, quas cum Mercurio in durabilem fluxum Mercurialem reduci poſſe deprehendi, ita alterare eum poſſint, ut ad incaleſcendum cum Auro ipſum diſponant. At non erat hoc ſatis ad eliciendum à me aſſenſum; ut enim ad Mercurios incaleſcentes admittendum adducerer, ſufficere non debebat, poſſibiles eos eſſe, vel etiam probabiles, ſed reverâ tales dari manifeſtâ probatione erat evincendum: Et hoc ipſum quoque, favente Deo, Experimenta mea, Anno 1652. *circiter, comprobarunt.*

Poſt aliquot ab eo tempore annos, quo Mercurium hujuſmodi jam poſſidebam, in quibuſdam ex eorum, quos turba Chymica Philoſophos nuncupat, libris obſcura quædam loca inveniebam, unde tunc eorum de ipſo, vel alio aliquo perquam ei ſimili, cognitionem conjectabam; atque in ipſorum uno reperiebam (non tamen rem totam in uno planè eodemque loco) deſcriptionem ejus Allegoricam, cujus pars maxima adeò difficilis intellectu mihi non erat: At cùm nihil ibi notatum viderem de illa Mercurii hujus proprietate, quâ calorem cum Auro acquirit, in ſuſpicionem incidi, eos vel cognitione illius fuiſſe deſtitutos, vel eam ſilentio premendam cenſuiſſe. At Tu ſine dubio facti potiùs Narrationes, quàm Conjecturas à me exſpectas.

reasonable, that, having but *mentioned* to you a Phænomenon whose Credibility is by many denied, I should take notice of some Circumstances fit to *bring credit* to it. And I shall the less grudge the pains of setting down several particular Phænomena, because I presume you have not met with them, and because also it may gratifie some of your Chymical friends, who may *have* or *discover* some noble Mercury, by helping them to examine it, and to try whether it resemble ours.

8. That I might not then be imposed on by others, I several times made trial of our Mercury, when I was all alone. For when no Body was by me, nor probably dreamt of what I was doing, I took to one part of the Mercury, sometimes half the weight and sometimes an equal weight of refin'd Gold reduced to a Calx or subtle Powder. This I put into the palm of my left hand, and putting the Mercury upon it, stirr'd it and press'd it a little with the finger of my right hand, by which the two Ingredients were easily mingled, and grew not only sensibly but considerably hot, and that so nimbly, that the Incalescence did sometimes come to its height in about a minute of an hour by

spectas. Et sanè æquum omninò fuerit, ut, cùm mentionem *duntaxat fecerim phænomeni, cujus à multis negatur credibilitas, circumstantias nonnullas annotem, quæ fidem ei conciliare valeant. Atque eò minùs laborem detrectabo particularia aliquot phænomena hîc tradendi, tum quòd ea Tibi non occurrisse autumem, tum quòd ea grata fore putem quibusdam amicis tuis Chymicis, nobilem quendam vel jam possidentibus vel paraturis Mercurium, ut scil. hoc qualicunque scripto nostro ad eum examinandum, &, an referat nostrum, experiundum, juventur.*

Itaque, ne mihi imponerent alii, pluries Mercurium nostrum, quando solus eram, explorabam. Etenim quando nemo mihi aderat, neque quisquam per somnium quid agerem conjiceret, sumebam unam partem illius Mercurii,, ad Auri, in calcem vel pollinem redacti, pondus quandoque dimidium, quandoque æquale. Hoc polline volæ manus sinistræ immisso, & Mercurio superinfuso, utrumque simul agitabam, premebamque nonnihil digito manûs dextræ; quâ ratione duo hæc Ingredientia facilè commixta, non modò ad sensum sed insigniter incalescebant, idque adeò properè, ut incalescentia interdum unius horæ circiter minuto, indicante idipsum horologio minutis instructo, ad ἀκμὴν perveniret. Succedebat hoc Experimentum,

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a Minute-Clock, I found the Experiment ſucceed, whether I took altogether, or but half as much Gold as Mercury; but the effect ſeemed to be much greater when they were employed in equal weight. And to obviate a ſuſpicion, which, though improbable, might poſſibly ariſe, as if the immediate contact of the Ingredients and the skin produc'd a ſenſe of heat, which was not due to the action of the Metals upon one another; I had the Curioſity to keep the mixture in a paper, and found not its interpoſition to hinder me from feeling the Incaleſcence, though it much abated the degree of my ſenſe of it.

mentum, ſive æqualem ſumerem ſive dimidiam Auri quantitatem; effectus tamen multò videbatur inſignior, quando æquali pondere adhibebantur. Atque, ut ſuſpicioni, quæ, licèt improbabilis, ſubnaſci tamen poſſet, occurrerem, immediatum ſcil. Ingredientium & Cutis contactum producere poſſe ſenſum Caloris, qui non debeatur Metallorum in ſe invicem actioni, curioſitate ducebar mixturam hanc in charta ſervandi; quo facto, interpoſitionem ejus nequaquam impedire incaleſcentiæ ſenſum comperiebam, quanquam, ex natura rei, intenſiorem illius gradum remitteret.

9. I tried alſo the ſame Mercury with refin'd Silver reduc'd to a very fine powder; but I could not perceive any heat or warmth at all; though I am apt to think, that if I had had a ſufficient quantity of leaf-ſilver to have made the experiment with, I ſhould after ſome time have produced an Incaleſcence, though much inferiour to what the ſame quantity of Mercury would produce with Gold; but this only upon the by. I ſhall now add, that to the end I might not be thought to impoſe upon my ſelf, I did not only make trial in my own hand, when 'twas in different tempers as to heat and cold, but I did it in the hands of others,

Porrò Mercurium eundem cum repurgato Argento, ad ſubtilem valdè pulverem redacto, exploravi; at nullum omnino calorem percipere potui; quanquam eò ferar ut exiſtimem, ſi ſufficiens Argenti foliati quantitas, ad peragendum Experimentum, mihi ſuppetiiſſet, me poſt aliquod temporis ſpatium incaleſcentiam ſuſcitaturum fuiſſe, quamvis multò inferiorem eo, quem eadem Mercurii quantitas cum Auro produceret: At hoc nonniſi in tranſitu. Adjiciam nunc, me, ne mihimet impoſuiſſe cenſerer, non tantùm rem hanc exploraſſe in manu mea, *quando variè erat pro caloris & frigoris ratione temperata, ſed & in manibus* aliorum, *quos non parùm attonitos*

thers, who were not a little surpris'd and pleased at the event. And this I did more than once or twice; by which means I had, and still have, divers Witnesses of the truth of the Experiment, whereof some are noted Persons, and especially him to whom I last shewed it, which you will easily believe when I tell you 'tis the Learned Secretary of the Royal Society; to whom having given the Ingredients, I desir'd him to make the Experiment in and with his own hands, in which it proved successful within somewhat less than a minute of an hour *

* *Since this was written, the Noble and Judicious President of the* Royal Society, *the Lord Viscount* Brouncker, *made the same Experiment with some of the same Mercury, in his own hand with good success.*

10. And that which makes this Incalescence the more considerable is, that being willing to husband my Mercury, a great part of which had been, as I ghess'd, stolen from me before I employed it, I made these trials but with a drachm at a time, which scarce amounts in quantity to the bigness of half a middle siz'd Bean; whereas, if I could have made the Experiment with a spoonful or two of Quicksilver, and a due proportion of Gold, 'tis probable the heat would have been intense enough, not only to burn ones hand,

habebat, juvabatque eventus. Atque hoc ipsum pluries quàm semel bisve feci; unde mihi testes suppetunt Experimenti veritatis assertores, probatæ fidei viri, quorum unus erat Eruditus Societatis Regiæ *Secretarius, quem, exhibitis ei Ingredientibus, rogabam, ut suis-met manibus Experimentum caperet; in quibus & optatum successum minori quàm unius minuti spatio sortiebatur* †.

† Ex quo tempore hoc literis fuit consignatum, Illustrissimus & Judiciosissimus *Regiæ Societatis* Præses, Dom. Vicecomes *Brouncker*, idem Experimentum suâ cum ejusdem Mercuuii portione, manu cum successu peregit.

Atque, quod Incalescentiam hanc insigniorem reddit, est, quòd, cùm parcè uti Mercurio meo cuperem, quippe cujus magna pars (ut conjicio) surrepta mihi fuerat, priusquam eum adhiberem, experimenta singula nonnisi cum una drachma peragebam, quæ vix fabæ mediocris dimidiæ magnitudinem æquat, cùm, si copia mihi fuisset capiendi Experimentum cum cochleari uno alteróve Mercurii pleno, supparique quantitate Auri, probabile sit, calorem inde oriturum fuisse satis intensum, ut non modò ureret manum, sed forsan & in Phiala vitrea rimas

hand, but perchance to crack a glaſs Vial; ſince I have ſometimes had of this Mercury ſo ſubtil, that when I employed but a drachm at a time, the heat made me willing to put it haſtily out of my hand.

11. Theſe things being matters of fact I ſcruple not to deliver them; but I would much ſcruple to determine thence, whether thoſe that are *Mercurii Corporum*, and were made, as Chymiſts preſume, by extraction only from Metals and Minerals, will each of them grow hot with Gold, as, if I much miſtake nos, I found *Antimonial Mercury* to do. And much leſs would I affirm, that every Metalline Mercury (though never ſo diſpoſed to Incaleſcence) or even that of Silver or Gold it ſelf, is the ſame with that which the Chryſopæan Writers mean by their *Philoſophick Mercury*, or is near ſo noble as this. Nay, I would not ſo much as affirm, that every Mercury, obtained by extraction, even from the perfect Metals themſelves, muſt needs be more noble and fit (as Alchymiſts ſpeak) for the Philoſophick work, than that which may with skill and pains be at length obtained from common Mercury skilfully freed from its recrementitious and heterogeneous parts, and richly impregnated with

rimas ageret; quandoquidem interdum hujus generis Mercurium habui adeò ſubtilem, ut, adhibente me ſingulis vicibus nonniſi drachmam unam, calor me adegerit ut properè è manibus mixturam deponerem.

Hæc, cùm ſint res facti, tradere non dubito; at valdè ambigerem exinde determinare, num qui appellantur Mercurii Corporum, *paranturque, ut jactant Chymici, ſola extractione ex Metallis & Foſſilibus, eorum quilibet calorem acquirat cum Auro, quemadmodum, ni multum fallor,* Mercurium Antimonialem *acquirere comperi. Multòque minus affirmarem, quemvis* Mercurium Metallicum *(quantumcunque ad Incaleſcentiam diſpoſitum,) quin & Mercurium Argenti Aurive ipſius eundem eſſe cum eo, quem Scriptores Chryſopæi per* Mercurium *ſuum* Philoſophicum *intelligunt, vel præſtantiâ ſuâ ad hunc accedere. Quin imò, ne quidem aſſererem, quemlibet Mercurium, extractione etiam ab ipſis perfectis metallis impetratum, nobiliorem eſſe oportere, & (ut loquuntur Alchymiſtæ) ad Philoſophicam operatiorem magis idoneum, quàm illum, qui,* peritiâ & induſtriâ *comite, obtineri* tandem *poteſt à* Mercurio vulgari, *à partibus ſuis recrementitiis heterogeneiſq; purgato, ſubtilibuſque & efficacibus metallorum Mineraliumve con-*

with the ſubtle and active ones of congruous Metals or Minerals. Theſe and the like points I ſhould, as I was ſaying, much ſcruple at offering to determine in this place, where what I deſign'd to deliver was Hiſtorical, though I have not thought it impertinent to glance at the points lately mention'd, becauſe thoſe glances may intimate things conducive to the better underſtanding of what I have ſaid, and have to ſay in this Paper.

gruorum partibus uberrime feto: Hæc, inquam, & ſimilia hoc loco affirmare admodum vererer; cùm hîc nonniſi ea tradere inſtituerim quæ ad rei Hiſtoriam faciunt; quanquam præter rem non exiſtimaverim, jamjam indigitatos rei hujus apices iunuere, quòd ſtrictura iſtæ ea poſſint Lectori ingerere, quæ ad meliorem tum dictorum tum dicendorum intelligentiam conducere queant.

12. I doubt not but what I have related and hinted has given you a Curioſity to know ſomewhat further of this Mercury: And I confeſs, that if there be any truth in what ſome of the moſt approved *Spagyriſts* have deliver'd about a Solvent of Gold that ſeems of kin, and perhaps is not much Nobler than one that I had; it ſeems allowable to expect, that even ours ſhould be of more than ordinary uſe, both in *Phyſick* and *Alchymy*. But the misfortune I had to have loſt a conſiderable quantity of it, being afterward increaſed by the almoſt ſudden death of the only Operator I truſted in the making of it; I was altogether diſcouraged from repeating ſuch a troubleſom Preparation, eſpecially being diverted by Buſineſs, Removes, Sickneſs, and more pleaſing

Non dubito, quin hactenus à me enarrata indigitataque Curioſitatem in Te pepererint, aliquid amplius de hoc Mercurio cognoſcendi: Et fateor, ſi quid veri ſubeſt ei, quod quidam ex probatiſſimis Spagyricis *de quodam Auri diſſolvente, quod affine videtur noſtro, nec eo fortè multò eſt nobilius, tradiderunt; exſpectare fas fuerit, ipſiſſimum hoc noſtrum in inſignem cum in* Medicina *tum in* Alchymia *uſum cedere poſſe. Verùm cùm infortunium illud, quo inſigniori quantitate ejus fui privatus, ſtipatum fuerit ſubitâ morte Operatoris unici, cui in eo parando penitùs fidebam, mentem planè alienam ab iteranda tam moleſta præparatione ſenſi; maximè cùm occupationes, migrationes, adverſa valetudo ſtudiaque gratiora aliorſùm me traherent; Et licèt Experimenta quædam non ſpernenda,*

fing Studies. And though I have not forgot ſome not deſpicable Trials that I made with our Mercury, yet ſince they are not neceſſary to the Queſtion that occaſioned this Paper, I ſhall paſs them over in ſilence, and only obſerve ſome few things I had almoſt forgot to tell you; namely firſt, that whereas 'tis uſual to take four, 5 or 6, nay 8 or 10 parts of common Quickſilver to make an Amalgame with one of Gold, even when both are heated by the fire; I found our Mercury ſo congruous to that metal, that it would preſently imbody with no leſs than an equal weight of it, and produce a pretty hard Amalgame or mixture, in which the Mercury was ſo diffuſed, that the Gold had quite loſt its colour. Secondly, I ſhall add what for ought I know has not been yet obſerved, that this power of penetrating Gold and growing hot with it, is ſo inherent, not to ſay radicated, in our Mercury, that after it had been diſtilled from Gold again and again, I found it to retain that property. And laſtly, whereas it may be ſuſpected that this faculty may be quickly loſt, (as that of the prepared *Bononian* Stone to receive Light, has been complain'd of as not durable) I found by trial that a ſingle drachm

da, cum Mercurio noſtro peracta, memoriâ meâ non exciderint; cùm tamen ad Quæſtionem illam, quæ ſcriptum hoc peperit, non ſint neceſſaria, ſilentio ea involvam, paucula duntaxat annotaturus, quæ commemorare propemodum fuiſſem oblitus. Quorum primum *eſt, quòd, cùm ſolenne ſit, capere Mercurii* vulgaris *partes quatuor, 5 vel 6, imò 8 vel 10, ad Amalgama faciendum cum una parte Auri, etiam tum quando utrumque incaluit igne; Ego adeò congruum deprehenderim cum metallo illo Mercurium noſtrum, ut non minus quàm æquale illius pondus intimè ſtatim pervaderet, ſatiſque durum Amalgama Cramáve produceret, in quo adeò diffuſus erat Mercurius, ut Aurum colorem ſuum penitus amitteret.* Secundum *eſt, (quod hactenus obſervatum fuiſſe haud putem,) vim ſcil. hanc, Aurum penetrandi cúmque eo incaleſcendi, mordicùs adeò inhærere Mercurio noſtro, ne dicam ita in eo radicatam eſſe, ut poſtquam iterum atque iterum ab Auro eſſet diſtillatus, proprietatis illius tenacem eum deprehenderim. Et* denique, *cùm ſuſpicio inceſſere Lectorem poſſit, facultatem hanc citò deperdi, (ut de præparato ad hauriendam lucem* Lapide Bononienſi *queruntur Authores,) experiundo didici; unicam drachmam Mercurii, certo modo parati,*

poſt

drachm of Mercury, made after a certain manner, did the third or fourth year after I had laid it by grow so hot with Gold, that I feared 't would have burnt my hand.

Thus far the Author to his Friend: But when he sent me the Paper, he accompanied it with the following lines;

13. I have little at present to say to you about the Papers which this sheet accompanies, save that one of the chief Reasons that makes me backward to have the foregoing Observations communicated to the Curious, is, that I fear, we may thereby procure divers Queries and perhaps Requests, (relating to this Mercury) which I would by all means avoid, for divers Reasons, and particularly for this, that a great weakness of that part disables me to write with my own hand, and I know, you will not think it fit, I should about such a subject employ that of an *Amanuensis*. And therefore I cannot consent, this Paper should go out of your hands, unless you can think on some likely course to secure me from trouble, and from the unwelcom necessity of disobliging some, whilst I endeavour to gratifie others. If this præcaution be used, I may safely learn by means of your diffus'd

post tertium quartúmve à quo Jeposueram annum adeò cum Auro incaluisse, ut ne adureret manum meam timerem.

Hactenus Author noster ad Amicum suum: *Sed cùm mihi Chartas illas mitteret, voluit eas sequenti mantissâ locupletare*;

Non diu te morabor differendo de chartis hîc junctis: Dicam solummodò, unam ex præcipuis rationibus, quæ in vulgandis prægressis Observationibus cunctabundum me faciunt, hanc esse, quòd vereor, nos hoc ipso variis circa Mercurium hunc Quæstionibus & fortè Sollicitationibus ansam daturos, quas omni studio præcavere velim, cum ob alias, tum hanc ob causam, quòd magna manuum mearum debilitas me impedit, quò minus meamet manu id consignare literis valeam, quod conscribi Amanuensis *operâ consultum haud judicaveris. Proindéque concedere haud possum, scriptum hoc è manibus tuis dimittì, nisi rationem suggeras probabilem, quâ securum me præstes à molestia, atque ab ingrata necessitate repulsam dandi nonnullis, dum aliis obsecundare studeo. Hac cautelâ si utaris, potero ampliſſimæ tuæ consuetudinis beneficio citra molestiam edoceri, quid ii, qui tantâ peritiâ tantoque judicio valent, ut in*

Ac-

hoc

Acquaintance, what thoſe that are skilful and Judicious enough to deſerve to be much conſidered in ſuch an affair, will think of our Mercury, and whether, in caſe they have an eſteem of it approaching to that of divers eminent *Chymiſts* (ſome of which importune me to impart it;) they judge the good, that the preparations of it (ſuch as *precipitats* and *turbiths* of divers kinds, *Mercurius dulcis*, *Cinaber* made of the ſulphur of Antimony, and with Gold, &c.) may do in Phyſick, is likely much to exceed the political inconveniences that may enſue, if it ſhould prove to be of the beſt kind, and fall into ill hands. The knowledge of the opinions of the wiſe and skilful about this caſe, will be requiſite to aſſiſt me to take right meaſures in an affair of this nature. And till I receive this information, I am obliged to ſilence.

14. Only in the mean while, I ſhall for the ſake of the Inquirers into Mercurial *arcana* make bold to add a Secret, which, I think, will to divers *Philalethiſts* and other ſtudents of the Chymical Philoſopers books ſeem a Paradox, if not an untruth; namely, That a Mercury, qualified to heat with Gold, and perhaps with other Powders, may be made by more waies than one or two; ex-

hoc negotio magni fieri mereantur, de Mercurio noſtro ſentiant; adhæc utrum, ſi æſtimationem de eo foveant illi ſupparem, quam præcellentium Chymicorum *complures* (*quorum nonnulli me urgent ad eum communicandum*) *præ ſe ferunt, veriſimile cenſeant, utilitatem, quam Præparationes ipſius* (*cujuſmodi ſunt* Præcipitata *&* Turbithi *diverſorum generum*, Mercurius dulcis, Cinnabaris *ex antimonio & auro cum parata, &c.*) *afferre poſſint rei Medicæ, longè ſuperaturam eſſe incommoda illa politica, quæ naſcitura forent, ſi fortè de præſtantiſſima eſſet indole, atque in maleferiatas manus incideret. Sapientum & peritorum hoc in caſu Opiniones cognoſcere, neceſſarium mihi fuerit, ut recto tramite in iſtiuſmodi negotio incedere mihi detur. Atque, donec edoctus id fuero, ſilentii ſacra colere teneor.*

Interim in eorum gratiam, qui Arcana Mercurialia *ſcrutantur, ſubjungere auſim ſecretum aliquod, quod* Philalethis *compluribus, aliiſque, qui Chymicorum Philoſophorum libris meditandis incumbunt, Paradoxum, quin & falſum fortè videbitur: Mercurium ſcil. ad incaleſcendum cum Auro aliiſve pulveribus idoneum, modis uno binóve pluribus parari poſſe; cùm per*

ex-

expe-

experience having assured me (whatever Authorities or Theories may be urged to the contrary) that such a Mercury may be (I say not, easily or speedily, but successfully) prepar'd, not only by employing Antimony and solid Metals as *Mars*, but without any such Metal at all, or so much as *Antimony* it self.

15. Here I purposed to conclude: But because I am, as you know, very averse (which I declare my self to be on this occasion also) from making any promise to the publick, I think fit in this place to give you an Advertisement, and obviate a Scruple. I shall therefore admonish those Inquisitive *Spagyrists*, that may be desirous to try, whether their purified Mercury be Incalescent, that they be not too hasty to conclude it is not so; nor to reject it, unless they have made the trial with Gold *duly* prepared. For I have found, that my Mercury did not grow hot with the smallest filings of Gold I could make (though indeed within a few hours after it did, without the help of fire, imbody with it into a hard *amalgama*,) which argued that the corpuscles of the Metal were not yet small enough to be suddenly penetrated by the Quicksilver: Nor will

experientiam certò mihi constet, (quicquid in contrarium obtendant Authoritates & Theoriæ) talem Mercurium *posse, (non dicam facilè properéve, sed cum successu) parari, non modò Antimonium solidáque Metalla, putà* Martem, *&c. adhibendo, sed citra ullius omnino Metalli, quin vel ipsius* Antimonii, *usum.*

Hîc statueram finem huic sermoni imponere: At cùm ægerrimè, ut nosti, tum aliàs, tum hac imprimis occasione, promissi fidem publico obstringam, visum est mihi hoc loco Monitum aliquod suggerere, & Scrupulo cuidam obviam ire. Prius quod attinet, Curiosos illos Spagyricos, *quos fortè tentandi cupido incesserit, sitne purgatus ipsorum Mercurius incalescendi qualitate instructus, monebo, ne nimis festinanter concludant ipsum eâ præditum non esse, néve eum rejiciant, nisi Experimentum fecerint cum Auro* ritè *præparato. Comperi quippe, Mercurium meum non incalescere cum ramentis Auri, omnium quas conficere poteram minimis, (quanquam reverâ intra paucas exinde horas, sine ignis adminiculo, cum ipso in durum amalgama conflaretur;) quod argumento erat, Metalli illius corpuscula necdum exigua satis fuisse, ut properè à Mercurio penetrarentur: Neque quævis Auri*

calx

will every *calx* of Gold ſerve our turn,, as I have found by employing, without ſucceſs, a very fine and ſpongy *calx* made after an uncommon way, the golden particles having, as it ſeem'd, ſome extremely fine though unobſerved duſt of the Additament ſticking to them, which hindered the adhæſion of the Mercurial ones. Now, the *calx* of Gold that I moſt uſed, as finding it ſtill to do well, was that made by *Quartation* || (as Alchymiſts call it.)

|| *That is, by melting together one part of fine Gold, and* 3 *or* 4 *parts of cuppell'd Silver, and then putting the maſs, wherein the Mettals are mixt, almoſt* per minima, *into purified* Aquafortis, *which diſſolving the Silver only, leaves the Gold in the form of a fine* calx.

calx rem noſtram conficiet; ut comperi, dum perquàm ſubtilem ſpongioſamque calcem, modo non vulgari paratam, citra ſucceſſum adhibui, in qua, ut videtur, apprimè tenuis ſenſumque fugiens Additamenti pulvis adhærebat particulis aureis, & Mercurialium adhæſionem præpediebat. Jam verò Calx auri, quâ plerumque utebar, ſucceſſu ejus inductus, illa erat quæ Quartationis † (*ut vocant*) *beneficio paratur.*

† Hoc eſt, per fuſionem conflando unam partem Auri puri, & tres quatuórve partes Argenti cupellati, ut vocant, & tunc immittendo maſſam, in qua Metalla miſcentur quaſi per minima, in purgatam *Aquam fortem*, quæ ſolum Argentum diſſolvens, Aurum in forma Calcis relinquit.

But becauſe 'tis not ſo eaſie, as even Chymiſts that have not tried imagine, to make good *calces* of Gold, and that in the way newly mentioned there needs fuſion of the Gold and of Silver (for which many Chymiſts want conveniences,) and they are often impoſed on by common Refiners, who here uſually ſell in wires ſuch Silver for fine (which indeed it is comparatively,) as I have found not to be without mixture; I ſhall add, that by making an *amalgama* the common way with pure Gold and vulgar Mercury, and diſſolving the Mercury in good Aqua-

At quia non adeò facilè eſt, ut ipſi Chymici, qui manum operi non admoverunt, ſibi imaginantur, bonæ notæ calces Auri parare, cumque in methodo jamjam memorata requiratur fuſio Auri & Argenti (cujus peragendæ commoditate non pauci Chymici deſtituuntur,) cùm etiam crebrò à vulgaribus Metallorum Purgatoribus fallantur, qui hîc paſſim, filorum formâ, ejuſmodi Argentum pro puro venditant (quale, comparatè loquendo, reverâ eſt,) quod non eſſe mixturæ expers deprehendi; adjiciam, quòd, dum communi more amalgama conficitur cum Auro

Aqua-fortis, there will remain a powder, which, being well washt with fair water to dulcifie it, and kept a while in a moderate fire to dry it throughly without melting it, will become a *calx*, which I have more than once used with our Mercury with good success. 'Tis true, both in this way and in that (by *Quartation*,) *Aqua-fortis*, which is a corrosive liquor, is employed to bring the Gold to powder, and therefore in a diffident mind some suspicion may arise, that the Incalescence may proceed only from the action of the acid particles of the *menstruum*, which yet adhering to the corpuscles of the Gold works upon the Quicksilver, as *Aqua-fortis* is known to do: But, to omit those answers that cannot be given in few words, after I have taken notice, that, if the effect depends not on our Mercury (as prepared) but only on the *calx*, it appears not, why this should not grow hot with common Mercury as well as with ours; I shall need to add, for the removal of this subtil scruple, no more, than this plain Experiment, (which I twice or thrice made,) namely, that taking, instead of a *Calx* of Gold, a competent number of Leaves of Gold, such as Book-binders and the

puro & Mercurio vulgari, Mercuriusque dissolvitur bonâ Aquâ forti; *remansurus sit pulvis, qui cum aqua pura, ad conciliandam ei, quam vocant, dulcedinem, probè elotus, & aliquandiu in temperato igne, ad eum penitus exiceandum citra fusionem, asservatus, talem Calcem præbebit, quâ pluries cum* Mercurio *nostro feliciter usus fui. Fateor equidem, tum in hac methodo, tum in illa quæ instituitur per* Quartationem, *adhiberi* Aquam fortem, *liquorem scil. corrosivum, ad Aurum in pulverem redigendum, unde scrutanti genio suboriri suspicio poterit, Incalescentiam illam soli actioni acidarum particularum Menstrui acceptam ferendam esse, quod hærens etiamnum Auri corpusculis, in Mercurium operetur, solenni* Aquæ fortis *more. Verùm, (ut eas responsiones sileam, quæ paucis tradi non possunt,) postquam notavi, quòd, si Effectus hic non dependet à Mercurio nostro (ritè præparato,) sed à sola Calce, non pateat, quare hæc non incalescat æquè cum Mercurio* vulgari *ac* nostro; *opus haud fuerit, aliud quicquam ad scrupulum hunc eximendum, quàm obvium hoc Experimentum, quod sequitur, quodque bis tèrve à me peractum fuit, adjicere: Sumpsi, inquam, Calcis Auri loco, sufficientem numerum Foliorum auri, qualibus utuntur Bibliopegi*

&

the Apothecary's use, this Gold, that was without the help of Salts reduc'd by beating to a sufficient thinness (insomuch that seventy odd Leaves did not weigh a scruple,) I found (more than once) upon putting two or three times the weight of our Mercury to them, that a smart heat was presently produced in my hand.

& Aurifabri; hoc Aurum, quod citra salium opem tundendo redactum erat ad tenuitatem sufficientem (adeò ut ultra septuaginta folia vix unius scrupuli pondus æquarent,) hoc, inquam, Aurum comperi (unâ vice pluries,) cùm binum trinumve Mercurii nostri pondus ipsi commiscerem, insignem in manu mea calorem mox peperisse.

Some Observations, sent by an Anonymous *to the Publisher, on several Passages in the two last Months Transactions, relating to some, till now* un-observed, *Qualities of the Air*; to *the Mixing and Fermenting of Liquors in* vacuo; to *the History of Birds*; *the Anatomy of the Trunks of Vegetables*; *Baroscopes, &c.*

Honoured Sir,

HAving long understood the freedom of address, you have allowed to any candid and unprejudic'd persons, whose general good wishes to the Common-wealth of Learning make 'em ambitious to impart something, whereby they may promote the Empire of Man above other Creatures; I flatter'd my self, it would be no unpardonable presumption, to communicate some of my thoughts unto you, on such a subject, as that the usefulness of the matter may keep me from seeming altogether impertinent, and the smalness of my performance, argue the greatness of my desires to serve you. This I resolved to do by way of Animadversions on the two last *Philosophical Transactions*; and though I performed nothing more, I hop'd at least, my Observations may do them the kindness, as shades intermixt with light, to render them more conspicuous. In hopes of this, I shall draw up my thoughts under this general Title of *Some Philosophical Observations on some passages in the two last Months Transactions*, viz. for *Decemb.* and *January.*

I highly applaud the bold design to discover some, till now unobserved, Qualities in the Air; and, though the difficulty of the Subject, and modesty of the Honourable Person, (less expected in

ſo great a Philoſopher, and ſo experienc'd a Chymiſt,) induce him to call them *Suſpicions*, yet the grounds he produces ſeem to raiſe them to the priviledges of *Aſſertions*: And though, as a late Obſerver on theſe Tracts ſaies on the ſame ſubject, 'tis only for the Sons of Art to make ſuch diſcoveries, and indeed the difficulty appropriates it to them; yet the meaneſt perſon may enjoy the benefits of ſuch performances, as we find in the diſcovery and uſe of the *Magnetick Needle*. For, it cannot be imagined, what immenſe profit may follow the knowledge of agreement between ſome Celeſtial and Terreſtrial Bodies; ſtrange effects will be then as eaſily produced, as now they are difficult to imagine. And truly this never enough celebrated Author, in his late Eſſay of *Hiſtorical relations*, *Obſervations and Experiments of Celeſtial and Aerial Magnets*, *the growth of Mettals in their Oar expoſed*, (they ſay Corn will ſo increaſe in Mow's by ſweating, and Coals in heaps) and *theſe Experiments*, ſeems to have put it out of doubt, that there are ſome Hidden qualities in the Air: But ſtill the queſtion returns, what they are; what their peculiar Effects and Cauſes; and I fear, theſe will long continue but *Suſpicions*.

My deſign in this Paper (becauſe the place of my reſidence at preſent denies me conveniencies for attempting the other kind of proof) is, to manifeſt *à priori*, that ſuch Suſpicions, and their grounds, the Experiments, may be reconciled to ſome received Theories: And as it is the buſineſs of the Honourable perſon to ſhew, they are highly countenanced by *Experiments*; ſo it ſhall be mine, to make it appear, they are conſiſtent with *Hypotheſes*, and with the Nature of the bodies in which they are preſumed to reſide.

Corroſions of bodies, eſpecially with a ſenſible motion, by emitting *effluvia*, which may alſo be ſpringy themſelves, if ſaline, may further bend the ſpringy particles of the Air, giving it a greater *Elatery*. On the contrary, other corroſions not ſo emitting, by different waies may weaken this ſpring; which effect, though at firſt ſight it may ſeem irreconcileable, may be leſs impoſſible, if we conceive the particles of the corroding liquor or *menſtruum*, of ſuch a penetrating and dividing nature, (the Eſſay of *Effluviums* manifeſting there are ſuch,) as by cutting or wearing of the ramous or ſtiff parts of the Aerious corpuſcles, which thus being ſmaller, loſe their bent, and become better qualified

to

to be extruded out of the glaſs, which leaving the other particles free from their preſſure, conſequently render them more at liberty, and leſs ſpringy. And this may have an intereſt in rarefaction of the Air, by what cauſe ſoever, as heat, cold, or taking away the uſual preſſion,&c.

I am not ignorant of what the excellent Author has delivered of the Impervioufneſs of Glaſs to Air; but then he means the true ſpringy Air, not that, which we ſuppoſe by its minuteneſs to have loſt its ſpring; and the particles of the Air in relation to their reſpective magnitude, may be compared to bullets, ſhot, and ſand mixt together: Or this corroſion may precipitate ſome part of the Air; which opinion they would favour, who ſuppoſe its particles Nitrous. 'Tis alſo eaſie to think, that the Air being a Rendezvous of ſo many Corpuſcles, and conſequently ſo heterogeneous a body, may be diverſly qualified by admitting *Effluvia* from ſolutions, which may remain unactive, till they meet with ſome body prediſpoſed to receive their operation; which, ignorance of the cauſe, and unexpectedneſs of the event (ſeeing it did not act on other bodies,) makes ſtrangely admirable.

In the *firſt* Experiment, the ſolution may acquire a brown colour by the *menſtruum's* imbibing the particles of Copper into it ſelf, which would alter its texture; and the impeding particles, diverſifying the refractions and reflections, may modifie the rays of light; or, as it is in Mr. *Newton*'s Theory, the ſolution may be qualified only to admit ſuch raies whoſe degrees of refrangibility, and mixture with other raies, may be prediſpoſed to give a Brown, (to ſhew what mixture or refraction makes this particular colour, I have not at preſent Mr. *Newton*'s Theory by me;) to which effect the Air did much contribute: But how far this and the following Experiments of the producing of Colours may countenance the ingenious Mr. *Hook*'s Hypotheſis, of Colours being made by the various concave ſurface of the reflecting Air, I recommend to further inquiry. Nay, the Air may be much concerned in the ſolution it ſelf, ſince it is allowed to be an Univerſal *menſtruum*, at leaſt of all Sulphureous bodies; and I wiſh it had been recorded †; Whether that ſolution was not ſomething ſooner made in the free Air, than in the Glaſs with the *hermetical* ſtopple

† *The Noble Author here meant, did purpoſely forbear to do what is here wiſhed, becauſe he was aware of the difficulty of determining it.*

ſtopple (I hope I may call it ſo, ſince 'tis as cloſe as the ſeal.) The *Spirit of Salt* may be ſaturated, its force ſpent, and vainly expect relief from the freſh Air, which the unkindneſs of the ſtopple denies. This removed, it may acquire its former quality by degrees, as the freſh Air did lower intrude it ſelf: It may again loſe it by being unaſſiſted, and let the particles precipitate, if any ſuch effect is obſerved; or the equilibration of the Air (for here 'tis not recorded, whether the Spring was weakned or no,) may contribute to ſuſtain the filings up in *æquilibrio*. If it long continue its commerce with the free Air, it may be enabled to continue its colour by having a more perfect mixture with the filings by the operation of the Air.

So perhaps in the *ſecond* Experiment the delay of regaining was to be imputed to the cold or moiſture, or other critical circumſtances of the Air, having leſs of thoſe diſſolving particles which make it a *menſtruum* on thoſe bodies.

In the *third* Experiment, beſide the former Obſervation, 'tis obvious to think, that the included ſpirit having ſpent its former force, may exerciſe ſome contrary quality on the bodies, enabled thereto by its heterogenity; nay, upon the readmiſſion of the Air, ſome of the Spirit of Filings may evaporate into the Air, which could not extricate it ſelf till helpt by that univerſal Solvent; ſo an alteration is made without a precipitation or ſediment.

In the *fourth* Experiment, the time of the year may add ſome quality to the Air, which thereby may act on the Saline ſpirit, by adding to it, or imbibing it, or invigorating it to evaporate, nay out of the Glaſs, if the parts are extremely comminuted.

And theſe things, however extravagant, are not difficult to imagine, and where the Experiments are but ſubſervient to Suſpicions, an hint of the poſſible cauſe of them *à priori* (ſince we know nothing of Nature that way, but by gheſſing its operation, as it, by Trials, repreſents it ſelf to our weak apprehenſion) will be pardonable, if but juſt removed from extravagance.

In the enſuing Trials, the weakned Spring is eſpecially obſerved where the Mercury in the ſeal'd leg was depreſſed, becauſe the Spring in the Conical glaſs and open'd leg yielded by being weakned; which invigorated again, reduced it ſelf to an *æquilibrium*. The Liquor in the *ſixth* Trial acquired a Blew colour, hich, according to Mr. *Newton*, is the reſult of the perfect mixture

ture of those raies, which according to their degrees of refrangibility are disposed to exhibit a Yellow and Green colour; which he declares by the instance of those two Powders mixt. Now, whether this Hypothesis, or Mr. *Hooke*'s, or that of *Descartes*'s, or the *Atomist*'s, may be most favoured hereby, I leave as an Inquiry, *viz.* Whether Colour is most referable to the predisposition of the Raies and internal texture; or the concave surface of the refracting and reflecting Air; or to the surface of the body, which diversly modifies the Corpuscles or Raies of light.

But in my simple judgment, the business will not bear a controversie, since each of these *may have*, nay certainly *has* a distinct intereſt in the phænomena of Colours, and the losing of the blew for transparent, and regaining it again by the Air's re-admission, seems to countenance the intereſt of the Air, which may be alter'd by losing some parts in operating on the Solution. The obviating of the objection of the powder remixt so regaining the colour, shows at once the ingenuity of the Author in taking notice of it, and the insufficiency of the Objection it self to challenge the effect from the Air. The mild operation of *Spirit of Vinegar* on *minium*, may not change the Air's spring, by extricating springy air out of the Vinegar to supply that it had imbibed, as it did an elastical substance in the notes. The diversity of the operation of *Sal Armoniac* might be refer'd to the strength of the Spirit; so may the quicknesse and length of retaining the colour and slowness of losing it; the weakness proceeding from the Air imbib'd, or dividing some of its particles to extrude them, as I noted before: In all which, critical times and qualities may be concern'd, which my weakness cannot examine; but hope, these Observations, as that Honourable person's Experiments, will give rise to further inquiries.

Those Ingenious *Frenchmen*, excited by Mr. *Boyle*, the Glory of Learning, as well as of our Nation, having given us an attempt of mixing and fermenting liquors *in vacuo*, do prosecute Fermentation, particularly of that in the growth of plants; how it may be impeded or promoted by the absence or presence of the Air. As for their taking the Receiver off from the Engine, I suppose, it could not be shaken but in the very moving *some* Air must get in, not so much, as sensibly to manifest it self in the Mercury, though sufficient

ficient to disturb the Experiment in Plants, and preservation of bodies, especially when added to the Air extricated from those bodies: And I the rather favour this suspicion, because all the bodies were something putrified, which Mr. *Boyle*'s exacter Experiments prevented. These Experiments further illustrated, will add much to the opinion of Respiration of Plants, and motion of their juices by the Air. The water through the trunk forms bubbles, because it meets with the Air in those pipes; through the leaves, only mild drops by a simple percolation.

In the continuation of *January*, by which and what Mr. *Boyle* has writ, we see the nature of the Air, its effects on bodies when present; by procuring its absence. Now Sir *W. Petty* can no more complain at the idle employment of Weighing Air; for the doctrine being well illustrated, and the Theory established, we thus descend again to more useful and grounded Experiments; as the method mentioned by my Lord *Bacon*, to proceed from Experiments to Axioms and Assertions; from these, as too general, to particular and useful Experiments, which before we could not do, till we had clear'd the Doctrine from wide and extravagant ghesses.

Fruits are neither exactly preserved in the free Air, nor quite without it; *that* too much exciting the prædatory Spirits to consume the more solid substance; the *want of Air* hurting them as much as it hinders Vegetation; which is obscurely performed in all conserved Fruits, the stem or externals supplying the office of the root: But Fruit is better in conservatories, where there is Air enough to nourish, but not to consume them. *Pag.* 494, where the *Cherries* are mentioned to be corrupted in less than an hour, when taken out of the *vacuum*, that may be referred to the exalted Spirit, which avolated on the first salute of the Air: That *Bread* yielded no Air, may be imputed to the open pores: That *Beef* yielded much springy Air, to the strong Saline spirit in the flesh.

The industrious Author of the *History of Birds* gives me occasion to wish, that some other would undertake that of other Creatures (the Preface seems to promise something, from that noble Author, of *Animals*,) as *Minerals*, *Insects*, *Fishes*, *&c.* reducing them to their Classes with Philosophical Observations, useful to illustrate many passages in Experimental Philosophy.

Where

The diligent Dr. *Grew* having given us an *Idea of a Phytological Hiſtory*, and the *Abſolute* and *Comparative Anatomy of Roots*, with the Theory of their Vegetation grounded thereon, here proceeds to *Trunks*; who, with the juſtly famous Signior *Malpighi*, hath diſcovered a new Philoſophical Country, which to the Ancients ſeemed barren, whoſe negligence would give it no other Name than that of *Terra incognita*. And, though I cannot but commend the proſecuted Analogy of *Plants* with *Animals*, in their Juyces and Veſſels, that by thoſe names of things well known in Animals they might be better underſtood; yet I would preſume to ſuggeſt, that the Analogy ſhould not be continued too far, as ſome have done to the aſſerting the Circulation of their Juyces, and perfect Organical Reſpiration, not conſidering, that the Variety of Nature may as much, nay more than the Conſtancy, make for her commendation. The Solar and Lunar motion of ſome Plants, may be another ſuſpicion of ſome latent qualities in the Air, and by their comparative Anatomy, as in the Spagyrical Anatomy of *Colcothar*, *&c.* noting what they have more or leſs than other bodies not ſo affected, we may ſearch out the cauſe of their Celeſtial or Aerial Magnetiſm.

By the *R. Almanack* we ſee, 'tis the ingenuity of this Age, that being freed from the ſlaviſh opinion of the government of the Planets, they cancel their power in Events, and ſhew their operation on the maſſes of Matter, and ſome peculiar ſympathizing bodies, as in the *Eſſay* of *Hidden qualities in the Air*; which is the true end and perfection of Aſtrology, and Natural Magick.

By accurate *Baroſcopes* we may regain that knowledge which ſtill reſides in Brutes, and *we* forfeited by not continuing in the open Air, as they do for the moſt part, and by Intemperance corrupting the *craſis* of our ſenſes. I remember, *Kircher* in his deſcription of *China* ſpeaks of a Stone, (how true I know not) which being made into a Human ſhape, by nature or art, by change of Colour prognoſticates Fair or Foul weather.

I am ſorry we were deprived in great part of Mr. *Flamſtead*'s Obſervations by the interpoſition of the Clouds, as if the modeſty of *Diana*, though twice eclipſed, had ſcarce thought it enough to hide her ſelf, from ſo acute a Diſcoverer.

Beſides the waies the Ingenious Dr. *Willis* (of whoſe loſs we are already ſenſible,) mentions, and all Peſtilential particles of the Air; the Lungs might be diſcompoſed by the variation of the Preſſure of the Air, and the Impotency of the internal to reſiſt it, or the weakned Spring of the external, and Elatery of the internal Air. By theſe performances we may rationally apply this Theory to particular Diſeaſes, and deſcend to them, ſince we know ſomething *à priori*; but ſtill with reſpect to the Conſtitution, Diet, Country, Education, &c. of the Patient.

By the *Germans* Eſſaies we may perceive the acknowledgment, our Neighbours make, or ought to make, of being awaken'd by the *Engliſh* to theſe Diſcoveries.

I cannot underſtand, why the Learned Dr. *Moor*, famous with us at *Cambridge*, ſhould reduce ſo many effects to any Principle diſtinct from the ſettled Laws of Nature and God's Providence, but that he is too much devoted to the Notions of the *Platoniſts* (as appears in all his Writings,) and other of the Ancients, that held the World *animate*; and this Spirit of Nature to be the Soul or Deity of it: For never any ſuppoſed both God and this Spirit. This explication of effects is no more than to ſay, 'tis produced by an Univerſal cauſe, as the Sun hardens Clay, ſoftens Wax, &c. But me thinks, he might have told us, *how* it acts, or what Natural means it uſes.

Now to give you ſome *promiſcuous* Obſervations as they occur to my memory: I have at *Cambridge* ſome of thoſe *Star-ſtones*, Mr. *Liſter* mentions in theſe Tracts, with ſuch joynts, found in a Brook near *Harborow* in *Leiceſterſhire*. There are alſo ſome *Thunder-ſtones* like the heads of Arrows, which being rub'd emitted a Sulphureous odour. Lately in *Shropſhire*, where I found theſe Stones, I took notice of a Shell impreſſing its ſignature on the Earth, which began to petrifie within it and look ſhelly. And I may ſuggeſt the Inquiry, whether thoſe Shells which are found in the ground, and ſeem to argue the Sea was once there, are not ſuch Geometrical effects of Nature, either by a Seminal principle from the Shells decaying, or the effects of the Accidental impreſſions from ſome Shells which came thither by accident. And this Doctrine might be much illuſtrated by ſome paſſages in the Eſſay of the *Origin of Gems*, receiving a ſignature when they and the Minerals

Minerals are in *Solutis principiis*; which Doctrine, as also that of Cold, Colours,&c. I wish the Honourable Person would comprehend in short †, as he has done his opinions of the Air, in the plain but elegant *Essay* of *Suction*, which hath procured many Votaries to his Doctrine.

† *This perhaps had been done, if this Author had not thought, that several of those Subjects, about which he hath deliver'd divers Historical particulars, were not yet sufficiently looked into, for him to frame* positive Hypotheses *of them.*

And it were to be wished, Monsr. *Le Grand*, who pretends to write for the Students of the University of *Cambridge*, (of which I must acknowledge my self an unworthy Member,) would take in Mr. *Boyle's*, Dr. *Willis*'s, and other Moderns Observations and Experiments, to illustrate Monsr. *Descartes*'s Doctrine; for it never was the design of this Ingenious Person, to have his writing Systematical, or think he had given us a Body of Philosophy, as M. *Le Grand* seems to make him; but rather upon some few Experiments he has rais'd a general Hypothesis, which is to be promoted or confuted by ensuing Experiments. But our late Author is so far from assuming Modern discoveries, that in his Natural history, speaking of the Elatery of *compress'd Air*, he seems purposely to have declin'd (for he could *not* be ignorant of so famous a doctrine,) mentioning the Spring of the *Free Air*: Though he lik'd not the opinion, at least he might have considered and explicated it to instruct the younger, without his applause or approbation.

Lately at *Cambridge*, at the dissection of a lusty Country-Curr, I observ'd two Spleens, the Vessels of the lesser, (though there was no great difference,) coming out of those of the greater. The Dog was long a dying, and had exceeding strong Lungs. The like may be usual to the Curious, though I never read of the like Observation.

Some Experiments touching Animals, *made in the* Air-pump *by the Persons formerly mentioned*, viz. *Monsieur* Hugens *and M.* Papin ||.

|| *Compare* Numb. 62 *and* 63 *of these Tracts, where many Experiments of this kind, made by Mr.* Boyle, *are recorded.*

ONe day I included in the *vacuum* an *Insect* which resembles a *Beetle*, but is a little bigger; and when I perceived it to appear dead, I gave it Air again, and it soon after recovered. Then I put it in the *vacuum* again, and having left it there, for an hour, I readmitted the Air, and found, that the Insect needed then much more time to recover. I included it there the third time, and having left it there two daies, I gave it Air again, and saw, it needed above ten hours before it began to stir again; yet it recovered well enough this time: But having put it in again the fourth time, and left it there eight daies, it would never stir again.

Intending to try the like upon a *Butterfly*, I saw, that when I readmitted Air to it, that the top of its back, which before was much swelled, did fall-in more than it should, and the Insect would not recover.

I also killed in the *vacuum* many Animals that breath, as *Birds*, *Mice*, *Rats*, *Rabbets*, *Cats*; and some of them I recovered by quickly giving them Air again, before the Engine was quite exhausted; but I never saw any of them revive, that had been in a perfect *vacuum*.

Monsieur *Guide* did make frequent Dissections of such Animals as we had thus killed, and observed among other things, that their Lungs fell to the bottom in water. In a little Book of his, printed of this Subject, he hath declared his opinion concerning this Experiment. He being a lover of truth, I am perswaded, he will not take it amiss, if I deliver my sentiment about it, which I think more probable than his.

He saith, that the Solidity or Closeness of the Lungs of Animals that have died in *vacuo*, comes from hence, that the Blood, which is propelled into the Lungs by the *Vena arteriosa*, doth so strongly press the *bronchi* of the *Arteria aspera*, that it expresses the Air out of them, and glues as 'twere their sides to one another. But for my part, I do not believe, that the Blood of the

vena

vena arteriosa can thus compress those *bronchi*, because that the said blood is inclosed in its vessels, that keep and hinder it from compressing others. Yet I am not ignorant, that the things that are included in the *Oesophagus* do indeed compress the *aspera arteria*, and that the *aspera arteria* by being fill'd compresses also the *Oesophagus*, upon the account of the scituation of these two conduits. But it appears not at all, that the smallest ramifications of those *bronchi*, and of the *vena arteriosa*, are scituate in the same manner; for, the *bronchi* being harder than the *arterial vein*, they will compress *it* more easily, than be compressed *by it*; and so, if you should blow them up with Bellows, they would glue the sides of that vein together, and hinder the Circulation: Which is directly contrary to the Experiment; as M. *Guide* himself observeth.

It is therefore far more probable, that, if the Lungs be compressed, that compression be made by the *pleura*, which may be swelled *within* the Breast, as the skin is swelled *without*. But it is not necessary, that the Lungs be *compressed* in *vacuo*, to make them subside in water. For I have divers times put pieces of Lungs and whole Lungs in the *vacuum*, and they remained there extremely swelled; but as soon as the Air was again intromitted, they became very flat and red, and sunk to the bottom in water. Which shews, that 'tis sufficient for getting the Air out of the Lungs, to render them close and red; and I have not been able to produce this effect but by means of the Exhausting Engin. For, I have left Lungs a whole night between two plates with a great weight upon them, to endeavour to express the Air out of them, but it would not succeed, and those Lungs did still float upon the water. I have also tried to make the Air re-enter into the Lungs after I had rendred them solid in the Engin, and *that* I found very easie; for, drawing them out from the bottom of the water, I did blow into the *aspera arteria*; and the Lungs swelled again and resumed their ordinary colour, and floated on the water. And this is that which befalls the Lungs of *Infants* new-born.

Promiscuous

Promiſcuous Experiments made in the Air-pump *likewiſe, by the ſame Perſons.*

WHen I began firſt to keep Receivers void of Air, after the manner above-recited, I made uſe of *Eels-skins* to apply them cloſe to the Cover. But I found them not proper for things that are intended to be conſerved a long time, becauſe by drying they grow ſpringy, and this ſpring is capable to raiſe the whole pillar of Air that preſſes the Receiver againſt its Cover; and ſo the Air gets in between, and fills the ſpace exhauſted.

Afterwards I employed *Mutton-skin*; but that ſticks yet leſs cloſe than an Eel-skin: For, aſſoon as the external Air comes to preſs upon it, it makes all the water, which wetteth the skin that ſtands over without, enter into the emptied Receiver, and you may ſee little drops of water coming out of the pores of the skin that is under the Receiver; and after the water is all entred, the Air quickly gets in the ſame way.

At length I took a *Lambskin*, and by means thereof I have kept Receivers empty eight daies together, and never perceived it fail. Yet, for greater ſecurity, I do put *Turpentine* round about ſuch Receivers as I mean to keep ſtaunch a long time. Mean while, this difference betwixt the skins of Mutton and Lambs is ſomewhat remarkable, and confirms what Phyſicians ſay of the different Conſtitution of bodies in Youth and old Age. I have afterwards found, that *Paper* wetted ſerves as well as a Lambskin; but you muſt put Turpentine about it before it be dry.

One day I cover'd a Receiver, whoſe fourth part was fill'd with water, and the reſt all empty. I put it over the flame of a Candle, and ſaw, that the water boiled very quickly, yet the glaſs not much heated; ſo that the water boiled near a quarter of an hour with a great ebullition, and the glaſs was no more than tepid. I then took it away from the flame, and ſaw, that the water continued a very great while boiling, and that it began again from time to time. I then believed, that the vapours, which had been raiſed into the Air, were recondenſed by the cold, and that that made the hot water bubble up, as water uſually doth when

when 'tis put into the Engine, and the Air that preſſes it exhauſted. Mean time, I have ſince made the ſame Experiment with a *Gage*, and I did not perceive, that all the bubbles that iſſued out of the water, made the Mercury riſe to ſenſe.

After this, I left my Receiver expoſed to the *Froſt*, and I found, that the Ice which was made therein was not yet quite free from bubbles, though the water thereof had boiled in the *vacuum*, which, one would think, ſhould have driven out all the Air: Yet the bubbles were there far leſs numerous than in Ice made of ordinary water. I perceived not, that the Quickſilver was much riſen in the *Gage*. Afterwards I melted this Ice, and put the water abroad to freez again, ſtill without taking it out of the *vacuum*, and I found, that this ſecond time it was very much freer from bubbles. The Glaſs did not break; but becauſe it was ſomewhat conical, we could not know, whether it remained whole upon the account of its *figure*, or becauſe that the water, which was frozen within, was freed of Air: And I could not make the Experiment with glaſſes of another figure, becauſe the Froſt did ceaſe.

After this, I made *Spirit of Wine* boil *in vacuo* in the ſame manner I did the Water; and I ſaw, that it boiled much ſooner. It made the Mercury riſe about an inch in the *Gage*. Then I took it from the fire, and ſaw it continue in its boiling; and even ſinking the Receiver into cold water, it thereupon boiled much more ſtrongly. One would think, this proceeded from an *Antiperiſtaſis*; but we have more ground to ſay, it came from hence, that the vapours of the Spirit were condenſed, and ſo made the Receiver more empty; which is ſufficient to make the Spirit of Wine boil, even though it were not hot. The Quickſilver did in two hours ſubſide again, to near half a line as low as it had been. Then I put the Receiver over the flame again, and made the Mercury riſe more than two inches; but then the Receiver cracked.

One day I took a *Tube of Plaſter* of *Paris*, open at one end, and cloſe at the other. I applied the open end to the cement as I was wont to do Receivers; and I ſaw it was not poſſible thus to exhauſt it, becauſe the *Air* did eaſily paſs *through* the Plaſter. I put therefore a Tube of Iron on the Engin, ſo as having filled it with water, the Tube of Plaſter was cover'd therewith; and

then

then having caused the Pump to be plied, I found, that the *Water* did pass *as easily* through the said Plaster. I therefore cover'd it with Venice-Turpentine instead of water, and then I saw, that it evacuated very well, and that nothing passed through it for the space of two hours. Then I took some Oyl very hot, and poured it over the Turpentine, which did melt by this heat and passed through the Plaster. Then I took off this Tube which was so pervaded by the Turpentine, and I saw, that that had made it transparent. Which effect is pretty like, and is to be explicated in the same manner as, [that of the little Stone called *Oculus mundi.* Thus we may be assisted by the *Weight of the Air* to make divers sorts of Glues penetrate Plaster, baked Earth, Wood, &c. And possibly those, who shall make a good number of such trials, will find their labour and pains recompenced, by giving to those materials such properties, as they never had before.

I did also put some *Eggs* in the *vacuum*, and one day I saw one of them break, which I had put in a small Receiver. It burst upon the very first suction: But since that time I could never make *any* break, though I exhausted as much as I could those Receivers wherein I had put some. You must therefore begin to crack them a little before you put them in the *vacuum*, and then they do easily break quite, and what is in the Egg riseth all into a very thick froth. I also put some of these, thus order'd, over the fire, where they boiled very easily, not being pressed by the Air, but they boiled there very long, before it began to appear that they were so boiled as to be ready to eat.

All the little bubbles that appear in *Mustard*, do swell and break in *vacuo*, and after that, the Mustard is seen to be without bubbles.

One day I included a *black Ribbon* in the *vacuum*, and then burnt it with a Burning-glass. Abundance of smoke issued out of it, which fell by little and little, and so permitted us to see the Ribbon plainly; which appeared not at all changed. But after I had returned the Air unto it, and touched it, I found it all turn'd to ashes.

Another time I caused also some *Gunpowder* to be burnt after the same manner; and I was much surprized to see, that it burnt grain by grain, none of the grains kindled firing those which touched. Another time when the Sun had less force, I could not

at

at all kindle the Powder, but I made it only boil and emit ſtore of ſmoke. I had put a *Gage* in the ſame Recipient, by means whereof I obſerved, that all that ſmoke produced no Air; for the Quickſilver did not riſe in the Tube. I noted alſo, that this ſmoak falling upon the Paſt-board, on which I had put the Powder, appeared yellow of the colour of Brimſtone. After that, I took out the Powder that remain'd, being like a black maſs, and having put it upon burning Coals, I ſaw it burned as doth Salt-Peter; and ſo it appear'd, that the ſulphur was almoſt all exhaled.

I was willing to reiterate this Experiment, and I then ſaw, that the Powder, after boiling, fuming, and being kindled grain by grain, (as in the firſt Experiment,) at laſt flaſhes out all at once, when one hath the patience to hold the fire to it with a Burning-glaſs. And when the fumes are grown clearer, you may ſee needles of Saltpeter ſticking to the ſides of the Receiver.

Another time, I put the weight of 12 or 15 *grains* of Powder in a glaſs ſhaped like a Cupping-glaſs, capable to hold 14 ounces of water, and having put fire to it, I made the Powder boil and ſmoak as uſually. Afterwards, ſeeing that the corns began to crack very near one after another; I then took away the burning Concave, for fear all ſhould be kindled together: But it was already too late; for, the corns did continue to crack longer than a ſecond of time, and at laſt all kindled, though there was then nothing left to heat them but the fire which they had kept within themſelves. The Receiver was lifted up above a foot high, without breaking.

Another time, I put the weight of 18 *grains* of Powder, together with a *Gage*, into a Receiver holding ſeven pound water; and I ſaw, that the Powder was more difficult to be kindled, than in ſmall Receivers. Yet at length it was kindled altogether, and made the Quickſilver riſe to the height of an inch and a half in the *Gage*; and I am very well aſſured, that all that Air was not come from without; for that part of the Receiver, to which the Cover is applied, had alwaies been under water.

From what I have been relating, it may be concluded, that there is a *fifth* part of Air in Gunpowder; ſuppoſing, as other Experiments do ſhew, that Air is about a *thouſand* times lighter than Water. For, in this Experiment, the Mercury did riſe to the *eighteenth* part of the height where the Air commonly ſuſtains

it; and consequently the weight of 18 *grains* of Powder did yield Air enough to fill the eighteenth part of a Receiver that contains seven pound of water. Now, this eighteenth part contains 49 drachms of water: Wherefore the Air, that takes up an equal space, being 1000 times lighter, weighs $\frac{1}{1000}$ of 49 drachms, which is more than $3\frac{1}{2}$ grains. It follows therefore, that the weight of 18 *grains* of Powder which I employed in my Experiment, contained more than $3\frac{1}{2}$ of Air, which is about the fifth part of eighteen grains.

It may also be calculated, how many times this Air hath been compressed in the Powder: But this calculation is more uncertain than the former, because we know not, whether this Air took up more or less than the fifth part of the space which the Powder possessed. But yet 'tis certain, that, though it had even taken up *three fourths* of the whole room of the Powder, and that the fourteen grains of the other matter had taken up no more than the one remaining fourth part, still this Air would have been compressed about three hundred times. To calculate this, I suppose, that the space of a Cubic foot can hold only 72 pound of Gunpowder, which do contain more than 14 pound of Air, by the foregoing *calculus*; which quantity of Air is therefore found inclosed in the *three fourths* of a Cubic foot. Now, this space doth usually contain but about six drachms of Air: Wherefore, to make it hold fourteen pound of Air, which is near three hundred times six drachms, it must needs be, that that Air be compressed near three hundred times.

There is reason to believe, that this Compression is much greater, because a Cubic foot can hold much more than seventy two pound of Powder, and because also that the *fifth* part of the weight must not, in appearance, possess alone the *three fourths*, and all the rest take up no more than *one fourth* of the space possessed by all the Powder.

I should therefore make no difficulty to believe, that all the effect of Gunpowder comes from the Air which is compressed therein, and especially in the Saltpeter; for I have not observed, that Brimstone yields Air. Possibly also we may find in time, that all other Fulminations, Ebullitions and Fermentations, that make such surprizing motions, are nothing else but Air compressed expanding it self.

An

An Account of two Books.

I. *COURS d'ARCHITECTURE, enſeigné dans l'Academie Royale d'Architecture, Premiere partie; par M.* Francois Blondel, *de l'Academiæ Royale des Sciences, &c. à* Paris, 1675. *in fol.*

IN this *Firſt Part* of Architecture (which noble Art the Eminent Author will doubtleſs purſue and improve in all its parts,) are explained the Origin and Principles of it, and the Practique of the Five Orders, according to the doctrine of *Vitruvius* and his principal Followers, and the doctrine of the three moſt renowned Architects that have written amongſt the Moderns, to wit, *Vignole*, *Palladio*, and *Scamozzi*.

For the Improvement of which Art his Majeſty of *France* hath inſtituted an Academy at *Paris*, which meets weekly to confer about that ſubject, and thereby endeavours to free Architecture from its vicious dreſſes, to retrench the abuſes which the ignorance and preſumption of Workmen had introduced, and to enrich the ſame with thoſe natural embelliſhments and graces, which have rendred it ſo commendable among the Ancient; not forgetting to teach in the ſame the exacteſt and moſt correct Rules of Architecture, and ſo to form a Seminary of young Architects, to be encouraged by certain *brabeums* or prices for ſuch as ſhall do beſt, and theſe to be ſent afterwards, at his ſaid Majeſties charges, into *Italy*, there to perfect their knowledge and skill, and ſo to be made capable to ſerve him in the Survey of his Buildings all over his Kingdom. And becauſe the knowledge of the precepts of Architecture is not ſufficient by it ſelf alone to make an Architect, this Skill ſuppoſing many other accompliſhments, the ſaid King hath appointed, that in the ſame Academy ſhould be taught the other Sciences that are abſolutely neceſſary to Architects, ſuch as are *Geometry*, *Arithmetick*, the *Mechanicks*, *Hydraulicks*, *Gnomonicks*, *Fortification*, *Perſpective*, and the like.

This *firſt* Part being merely Practical as to the *Five Orders*, the Author hath altogether applied himſelf to ſhew with great plainneſs, which are the moſt correct Practiſes to be uſed therein, beginning with that of *Vitruvius*, and explaining him by the Practick of his beſt Interpreters or Imitators, ſuch as are *Philander*, *Daniel Barbaro*, *Serlio*, *Alberti*, *&c.* And ſeeing that the doctrine of *Vitruvius* is merely that of the *Grecian* Architects that had preceded

him, and that those that came after him and the *Romans* have much improved those first Inventions; this Author, unwilling to subject his Auditors altogether to the precepts of that ancient Writer, hath chosen among the Moderns those three Architects, that have the most universal approbation, to deliver their thoughts upon each of those Orders, and to give us the *easiest* means to put them in practise; for which end he hath not scrupled to make several alterations in their method.

In the Second he intends to be much larger, and fully to explain what hath but been touched in this First part, and to compare the Sentiments which Architects have entertained amongst themselves, concerning the best Examples of the Ancients. And 'tis hoped, he will hasten so desirable a work, as much as the nature of it will bear.

II. *Remarks upon Two late Ingenious Treatises; the one, an Essay touching the Gravitation and Non-Gravitation of* Fluid Bodies; *the other, Observations touching the* Torricellian Experiment, *so far forth as they may concern any Passages in the* Enchiridium Metaphysicum: *By Dr.* Henry More. *Printed in* London, *for* Walter Kettilby, 1676. *in octavo.*

WE shall, instead of giving an account of this Tract, desire the Reader to compare with it what hath been not long since publisht by those two eminent Philosophers, Mr. *Boyle*, and Dr. *Wallis*; the *former*, in an *Hydrostatical Discourse, occasion'd by the Objections of this Learn'd Author against some Explications of New Experiments made by the said Mr. Boyle*; which was printed at *London* for *Richard Davis*, 1672. amongst some other Tracts, *viz. New Experiments touching the Relation betwixt* Flame *and* Air; *of the Positive or Relative Levity of Bodies under Water; of the Airs Spring on Bodies under water, &c.* The *latter*, in a *Discourse of* Gravity *and* Gravitation, *grounded on Experimental Observations, presented to the R. Society*; printed for *John Martyn, &c.* 1675. These pieces being well laid together, and the doctrine of Hydrostaticks well understood and applied, will make it easie to the Judicious and considerate Reader, what to judge of the whole controversie here treated of.

Errata.

P. 523. l. 29, 30. leg. *eâ quam*; p. 524. in not. †, lege, *Experimentum cum ejusdem Mercurii portione, in sua manu*; p. 529. l. 14. leg. *cum auro para.*

London, Printed for *John Martyn*, Printer to the *R. Society*, 1675.

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